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Energy Research Abstracts

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UNITED STATES DEPARTMENT OF ENERGY

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Energy Research Abstracts

Purpose

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U.S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. Foreign information is obtained through the International Energy Agency's 14-nation Energy Technology Data Exchange, the International Atomic Energy Agency's International Nuclear Information System, or nation-to-nation agreements. **Please note that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.**

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The citations presented in *ERA* are available for on-line searching as records within the Energy Data Base. The current-year records are available on the Integrated Technical Information System (ITIS). The entire data base is available through commercial on-line vendors.

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Managing Editor, Audrey B. Smith
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Information Sources

The citations presented in *Energy Research Abstracts* are a subset of the worldwide energy information provided to the Office of Scientific and Technical Information (OSTI) through exchange agreements with foreign sources and through exchanges or contracts with U.S. organizations.

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7. **Corporate author(s)** identifying corporation responsible for document.
8. **Patent assignee and number** for citations of patent documents or applications.
9. **Journal title, volume, and issue** for citations of journal articles.
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18. **Conference title, location, and date,** if applicable.
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21. **Drop note** or explanatory statement.
22. **Abstract.**
23. **Subject descriptors.** Listed only if no abstract or only a brief statement is included.

Sample Citations

Report

1849 (DOE/ER/40438–T1) **[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report.** Haeberli, W. Phys. VI collaboration. Wisconsin Univ., Madison (USA). Dept. of Physics. [1989]. 12p. Sponsored by DOE Energy Research. DOE Contract FG02-88ER40438. Order Number DE89007246. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper briefly discusses the Wisconsin test facility for storage cells; results of target tests; the new UHV...

Report Analytic

18500 (INIS-SU—69, pp. 30-32) **Transition energies in Ne-like ions. Correlation effects.** Vainshtejn, L.A. AN SSSR, Moscow. Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics. Collection.* Order Number DE89780060. Available from NTIS (US Sales Only), PC A03/MF A01; INIS.
Kratkie Soobshcheniya po Fizike.; no. 6.

SILVER IONS/energy-level transitions; XENON IONS/energy-level transitions; CORRELATIONS; D STATES; E STATES;...

Journal Article

19055 **A theoretical and experimental investigation of long-pulse, electron-beam-produced rare gas plasmas.** Brake, M.L.; Repetti, T.E. (Energy Beam Interaction Lab. of the Dept. of Nuclear Engineering, Univ. of Michigan, Ann Arbor, MI (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science (USA),* 16(5): 581-589 (Oct 1988). (CONF-881020–: Symposium on radiation physics, Sao Paulo, Brazil, October 3, 1988).
Visible emission spectroscopy (380-650 nm) has been performed on intense, electron beam (1 kA, 300 ns, 300 kV) produced Ar, Kr,...

Patent

18045 **Polarization of fast particle beams by collisional pumping.** Stearns, J.W. To Dept. of Energy, Washington, DC. USA Patent 4,724,117. 9 Feb 1988. Filed date 19 Oct 1984. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

A method for polarizing a fast beam of particles by collisional pumping, comprising the steps of generating a beam...

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Corporate Author Index
The corporation, organization, or institution responsible for the issuance of the document is listed in this index. The entries are arranged alphabetically and provide the title and citation number of the reference. For example, the listing for the "Report" sample citation would appear as shown at right.

Wisconsin Univ., Madison (USA). Dept. of Physics
[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 14:18494 (R;US)
Wisconsin Univ., Madison (USA). Lab. of Genetics
Organization of the R chromosome region in maize: Final progress report, June 1, 1983–May 31, 1986, 14:18255 (R;US)

Personal Author Index
Each author's name listed on a document cited in this issue is indexed. An index entry provides title and citation number; for secondary and other names, a cross-reference is given to the primary author name where the full index entry is located.

Hadley, D.L., *See* Lee, A.D., 14:17651
Haeberli, W., [Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 14:18494 (R;US)

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This index lists the main subject descriptors assigned to each record by indexing professionals. A secondary or qualifier term is used where necessary to describe materials, objects, and processes. Document titles may be enhanced with additional informative phrases where necessary. An excerpt from this index appears at right.

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Study on the strong neutron-rich nuclei of lightest elements, 14:18686 (RA;SU;In Russian)

Contract Number Index
DOE technical reports are listed by contract number. Each entry also provides the primary corporation or organization cited for that contract number. A typical entry is shown.

FG02-88ER40438 **Wisconsin Univ., Madison (USA). Dept. of Physics**
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Report Number Index
Technical report literature is indexed by the alphanumerical identifier of the report. Patent documents and conferences are included for convenience. Each entry lists the citation number, the source of availability of the document, an indicator of presence at a GPO depository library, order number, and distribution category. A typical entry is:

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The subject content of *Energy Research Abstracts* is arranged as shown below. The two-digit and four-digit category numbers printed here illustrate the category number assignment used in the data base records.* The following list includes all of the 40 first-level and the 289 second-level categories. Because each issue of *ERA* publishes citations only for those documents announced during the past semimonthly period, some subject categories may not be present in every issue.

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*The numerical subject category scheme is used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's data systems. Categories and definitions for the complete set of six-digit numbers are given in DOE/TIC-4584, *Energy Data Base: Subject Categories and Scope*.

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Energy Research Abstracts

01 COAL AND COAL PRODUCTS

0103 Preparation

Refer also to citation(s) 51667

51619 (DOE/PC/88878–T4) **Coal surface control for advanced fine coal flotation: Quarterly report, April 1, 1989–June 30, 1989.** Fuerstenau, D.W.; Sastry, K.V.S.; Hanson, J.S.; Narayanan, K.S.; Urbina, R.H.; Diao, J.; Yin, Y.; Harris, G.; Hu, Weibei; Zou, Y.; Chen, W.; Somasundaran, P.; Harris, C.C.; Vasudevan, T.; Xhong, K.; Xiao, L.; Choudhry, V.; Shea, S.; Ghosh, A.; Sehgal, R. Columbia Univ., New York, NY (USA); Utah Univ., Salt Lake City, UT (USA); California Univ., Berkeley, CA (USA); Praxis Engineers, Inc., Milpitas, CA (USA). 15 Aug 1989. 155p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88878. Order Number DE90001157. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

The primary goal of this project is to develop advanced flotation methods for coal cleaning in order to achieve 90% pyritic sulfur removal at 90% Btu yield, using coal samples procured from six major US coal seams. Concomitantly, the ash content of these coals is to be reduced to 6% or less. Investigation of mechanisms for the control of coal and pyrite surfaces prior to fine coal flotation is an important aspect of the project objectives. Large quantities of coal samples have been procured from six major seams. Samples of the same coals are also to be supplied to the University of Pittsburgh for selective agglomeration research. A second objective is to investigate factors involved in the progressive weathering and oxidation of coal stored in three storage modes, namely, open, covered and in an argon-inerted atmosphere, over a period of twelve months. After regular intervals of weathering, samples of the three base coals are to be collected and shipped to both the University of Pittsburgh and the University of California at Berkeley for characterization studies of the weathered coals. Work is divided into 8 tasks: (1) project work plan; (2) coal procurement and weathering; (3) coal characterization; (4) standard beneficiation test; (5) grinding studies; (6) surface modification studies; (7) exploratory R&D and support; and (8) task integration and project management. 8 refs., 50 figs., 38 tabs.

0104 Processing

Refer also to citation(s) 51662, 51663, 51664, 51701, 52147

51620 (CONF-891046–1) **Identification of materials for hot-gas filter tubesheets: Period of performance: October 1, 1988–October 1, 1989.** Swindeman, R.W. Oak Ridge National Lab., TN (USA). [1989]. 6p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC05-84OR21400. From Advanced research and technology development; Morgantown, WV (USA); 3-5 Oct 1989. Order Number DE90000706. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This research attempts to identify potential problem areas and to recommend materials and design methodologies that will mitigate problems that could significantly limit the life of filter element support components (tubesheets). A plan was developed and work initiated to assess candidate materials for the construction of tubesheets. Initial efforts were directed toward the system to be installed at the PFBC in Brilliant, Ohio. The plan called for a conceptual scaleup of the Grimethrope tubesheet with the same material, a similar design with a stronger material, and an alternate conceptual design concomitant with the best material. To meet anticipated needs in regard to detailed analyses and life prediction, the plan called for the expansion of the high-temperature materials data base to include thermal and mechanical fatigue and the development of a defensible design methodology. 5 refs., 8 figs.

51621 (CONF-8808104–) **Bioprocessing of coals workshop-III: Proceedings.** McIlwain, M.E.; Dugan, P.R. (eds.). USDOE Assistant Secretary for Fossil Energy, Washington, DC (USA); US-DOE Idaho Operations Office, Idaho Falls, ID (USA); Idaho National Engineering Lab., Idaho Falls, ID (USA). [1988]. 271p. Sponsored by U.S. DOE Fossil Energy. From 3. bioprocessing of coals workshop; Tysons Corners, VA (USA); 15-17 Aug 1988. Order Number DE90000890. Available from NTIS, PC A13/MF A01 - OSTI; GPO Dep.

Bioprocessing of coals is an area of immerging technology which is beginning to be given considerable research attention. This workshop is the third in a series of annual forums intended to bring together workers in the field to discuss progress, results, and opportunities. Three years ago, this workshop was one of only a few forums where research dealing specifically with biological treatment of coal and coal derived materials was discussed in a concerted manner. Now, there are numerous meetings and symposia where these results are being presented. This growth in topical meetings is a reflection of the increased interest in both the technical community and funding agencies for the potential of bioprocessing of coals. Bioprocessing of coals is on the verge of becoming an accepted means to treat coal. Twenty-one research programs are included in this report. Individual projects are processed separately for the data bases.

51622 (DOE/FE–0137) **Comprehensive report to Congress Clean Coal Technology Program: Innovative coke oven gas cleaning system for retrofit applications; A project proposed by Bethlehem Steel Corporation.** USDOE Assistant Secretary for Fossil Energy, Washington, DC (USA). Office of Clean Coal Technology. Aug 1989. 36p. Sponsored by U.S. DOE Fossil Energy. Order Number DE90000952. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This proposed project is to demonstrate an innovative technology that removes sulfur-bearing compounds and ammonia from coke oven gas (COG) before it is used as a fuel in the steel mill. Approximately 80 percent of the sulfur and 98% of the ammonia is removed from the COG. This project will also reduce benzene and hydrogen cyanide emissions. The proposed technology is a first-time integration of four commercially available technologies. The four steps, or stages, in the proposed process are the following: secondary gas cooling; hydrogen sulfide and ammonia removal; hydrogen sulfide and ammonia recovery; and ammonia destruction and sulfur recovery. The process uses contaminated water produced in the coke oven plant to absorb sulfur compounds and ammonia. Both the sulfur compounds and ammonia are steam stripped from the contaminated water, and then the ammonia is destroyed in a catalytic reactor. This reactor is followed by a conventional Claus Plant that catalytically converts the sulfur compounds to elemental sulfur, which is sold. Since each process unit has individually achieved commercial status, the technical risk for the project is significantly reduced. The benefits of this process are the reduction of sulfur, ammonia, and organic compound emissions in the plant, and no production of a solid waste. 6 figs.

51623 (DOE/MC/23075–2744) **Measurement and modeling of advanced coal conversion processes: 11th quarterly report, April 1, 1989–June 30, 1989.** Solomon, P.R.; Serio, M.A.; Hamblen, D.G.; Smoot, L.D.; Brewster, S. Advanced Fuel Research, Inc., East Hartford, CT (USA); Brigham Young Univ., Provo, UT (USA). Jul 1989. 160p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-86MC23075. Order Number DE90001209. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

The overall objective of this program is the development of predictive capability for the design, scale up, simulation, control and feedstock evaluation in advanced coal conversion devices. This technology is important to reduce the technical and economic risks inherent in utilizing coal, a feedstock whose variable and often unexpected behavior presents a significant challenge. The foundation to describe coal-specific conversion behavior will be AFR's Functional Group (FG) and Devolatilization, Vaporization, and Crosslinking

(DVC) models. These models have demonstrated the capability to describe the time dependent evolution of individual gas species, and the amount and characteristics of tar and char. The FG-DVC model will be integrated with BYU's comprehensive two-dimensional reactor model, PCGC-2, which is currently the most widely used reactor simulation for combustion or gasification. The program includes: (1) validation of the submodels by comparison with laboratory data obtained in this program, (2) extensive validation of the modified comprehensive code by comparison of predicted results with data from bench-scale and process scale investigations of gasification, mild gasification and combustion of coal or coal-derived products in heat engines, and (3) development of well documented user friendly software applicable to a "workstation" environment. 92 refs.

51624 (DOE/MC/23288–2741) **Steam conditioning of coal for synfuels production: Fifth quarterly report, January 1–March 31, 1988.** Graff, R.A.; Zhou, Peizheng. City Coll., New York, NY (USA). 1988. 16p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-87MC23288. Order Number DE90001104. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Conditioning of coal in steam is being explored for the purpose of improving the yields and quality of condensable product obtainable in the mild gasification of coal. Construction of the fluidized bed mild gasification test facility was completed and shakedown runs immediately commenced using Illinois No. 6 coal. Excellent performance was obtained from the fluid bed and no difficulties with agglomeration encountered. Initial trials showed the need to trap condensable product after the reactor in order to prevent fouling of heat transfer surface in the collection system. Traps were designed, fabricated and installed. Successful system operation was then obtained. 1 fig., 2 tabs.

51625 (DOE/METC–88/6097) **Proceedings of the fourteenth annual underground coal gasification symposium.** Bartke, T.C.; Hill, V.L. (eds.). USDOE Morgantown Energy Technology Center, WV (USA); Gas Research Inst., Chicago, IL (USA). Aug 1988. 415p. Sponsored by U.S. DOE Fossil Energy. (CONF-880874–: 14. annual underground coal gasification symposium, Schaumburg, IL (USA), 15-18 Aug 1988). Order Number DE88001093. Available from NTIS, PC A18/MF A01 - OSTI; GPO Dep.

The Fourteenth Annual Underground Coal Gasification Symposium was co-sponsored by the Laramie Projects Office of the Morgantown Energy Technology Center (METC) and the Gas Research Institute (GRI). This year's symposium was hosted by METC in Chicago, Illinois, August 15-18, 1988. The purpose of this annual meeting is to provide an opportunity for scientists working in the technology to present their research results, exchange ideas, and discuss their future plans. There were nearly 100 attendees from US industry, academia, and Government and nine foreign countries: Australia, Belgium, East Germany, India, Japan, the Netherlands, the United Kingdom, Yugoslavia, and West Germany. Forty-two technical papers were presented in six sessions: Session 1 – Poster Session, Session 2 – Modeling/Experimental Research, Session 3 – Field Studies at Rocky Mountain 1, Session 4 – Environmental Aspects, Session 5 – Environmental Workshop, and Session 6 – General Subjects. These Proceedings also includes five additional papers that were submitted for publication but were not presented during the conference. Individual projects are processed separately for the data bases.

51626 (DOE/PC/79936–5) **Low severity conversion of activated coal: Quarterly report No. 5, September 1, 1988–November 30, 1988.** Hirschon, A.S.; Ross, D.S. SRI International, Menlo Park, CA (USA). Jan 1989. 15p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-87PC79936. Order Number DE90000082. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We have made advances at SRI in both the thermal and hydrotreating stages that can be applied to develop a more rational coal liquefaction scheme. The essence of our approach to liquefaction is to (1) increase both the reactivity and accessibility of coal by pretreatment and (2) use the bond-breaking capacity of reactive catalysts well dispersed within the coal structure. With this approach we can expect moreover to minimize or eliminate the bond-generating or retrogressive reactions working at cross-purposes to coal liquefaction. The program to be conducted on this contract is composed of four tasks. The first was the preparation of the project work plan. Task 2 is a systematic study of compositional and morphological changes brought about by hydrothermal pretreatment. Our goal is to develop an understanding of the pretreatment effect mechanism. Task 3 is the preparation of soluble organometallic clusters. Guided by our results from our previous contract, efforts will be made to develop soluble, highly reactive metal cluster promoters for the hydrogenolysis of the heteroatom linkages and phenolic C-O bonds in coal. The work will involve a detailed survey using a series of model materials. In Task 4 we will link the pretreatment step from Task 2 with dispersed high-activity hydrogenolysis catalysts synthesized in Task 3, thus maximizing the conversion of coal to soluble products and minimizing any retrogressive reactions. 11 refs., 2 figs., 4 tabs.

51627 (DOE/PC/80502–T15) **Interactive chemistry of coal-petroleum processing: Quarterly report, June 16–September 15, 1989.** Curtis, C.W.; Guin, J.A.; Tarrer, A.R. Auburn Univ., AL (USA). Dept. of Chemical Engineering. 1989. 34p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-85PC80502. Order Number DE90001664. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objective of this project is to investigate the interactive thermal and catalytic chemistry of coal and petroleum processing using model compounds and actual petroleum-coal materials. Major tasks include: (1) Evaluate the thermal chemistry in three different model coal-petroleum systems composed of (a) hydrocarbons, (b) hydrocarbons and compounds containing heteroatoms and (c) hydrocarbons, heteroatomic species and metalloporphyrins; (2) Evaluate the catalytic chemistry of coal-petroleum processing using three different model systems – hydrocarbons, heteroatomic species and metalloporphyrins with selected transition metal sulfide catalysts; and (3) Evaluate the thermal and catalytic chemistry of actual coal-petroleum systems. 14 refs., 4 figs., 13 tabs.

51628 (DOE/PC/88806–T1, pp. 4-13) **Coal desulfurization by bioprocessing.** Bhattacharyya, D.; Aleem, M.I.H.; Kermode, R.I.; Khalid, A.M.; Hsieh, M.; Francis, H. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (USA). 1988. In *Cooperative research in coal liquefaction infratechnology and generic technology development. Quarterly report, May 1, 1988–July 31, 1988.* Order Number DE89003427. Available from NTIS, PC A05/MF A01.

Dibenzothiophene (DBT) one of the forms of organic sulfur which occurs in coals is transformed by myriads of soil microorganisms, predominant of which are aerobic, gram negative rods. Pseudomonas and other related types of microorganisms are well known for their DBT degradative activities. Pseudomonas most commonly associated with DBT degradation are Pseudomonas putida, Pseudomonas alcaligenes, and Pseudomonas stutzeri. Both Pseudomonas putida and Pseudomonas alcaligenes have been found to contain a 55 megadalton plasmid which enables these strains to oxidize naphthalene and slaicylate, and induction of DBT oxidizing capability to these bacteria have also been demonstrated by addition of DBT, benzene, naphthalene and anthracene to the microbial cultures. A novel desulfurization pathway has been reported for DBT where it is oxidized to DBT-5-oxide by a soil isolate (Pseudomonas putida) which oxidizes it further to sulfate and 2-2'-dihydroxy biphenyl. The oxidative ability of Pseudomonas putida was found to be dependent upon the addition of sodium benzoate, which probably induces enzymes necessary for this transformation. In the light of the above facts, it seemed logical to assume that bacteria capable of growing on sodium benzoate should be capable of removing organic sulfur from the coals. Therefore, bacterial cultures were first adapted to grow on benzoic acid and then these cells were used for desulfurization studies of coal samples. Results from these studies are given and discussed.

51629 (DOE/PC/88806–T1, pp. 14-21) **Materials characterization study of coal liquefaction processes.** Huffman, G.P.; Huggins, F.E.; Reucroft, P.A.; Subbaswamy, K.; Clouthier, D. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (USA). 1988. In *Cooperative research in coal liquefaction infratechnology and generic technology development. Quarterly report, May 1, 1988–July 31, 1988.* Order Number DE89003427. Available from NTIS, PC A05/MF A01.

Four studies are described. XAFS (X-ray Absorption Fine Structure) spectroscopy studies focused on analysis of spectra of

standard sulfur compounds and application of the method to sulfur in coal macerals (inertinite, vitrinite, exinite). Surface studies of coal were initiated in two areas: nitrogen BET surface area and a literature review of previous work on coal characterization by XPS (X-ray Photoelectron Spectroscopy) and other surface analysis techniques. Spectroscopic studies were undertaken to probe the transient and intermediate species produced in the pyrolysis of organic sulfur compounds of importance in natural fuels. Techniques used included laser spectroscopy, supersonic pyrolysis jet spectroscopy, and FTIR spectroscopy. The fourth project consists of electronic structure calculations and theoretical studies of coal macerals and model compounds. The status and results to date are described for each project.

51630 (DOE/PC/88806–T1, pp. 22) **Coprocessing of coal with heavy oil and petroleum residuals.** Tierney, J.W.; Wender, I. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (USA). 1988. In *Cooperative research in coal liquefaction infratechnology and generic technology development. Quarterly report, May 1, 1988–July 31, 1988.* Order Number DE89003427. Available from NTIS, PC A05/MF A01.

Work has been carried out on the low- and high-temperature catalytic applications of transition metal carbonyl (TMC) catalysts to coprocessing. The activity of cobalt carbonyl ($Co_2(CO)_8$) has been demonstrated as a homogeneous catalyst in the low-temperature hydrogenation of anthracene, a polynuclear aromatic hydrocarbon typical of some structures in coal, to 9, 10-dihydroanthracene. Reactions were also carried out on coprocessing feedstocks with iron pentacarbonyl at high temperatures (> 400°C) in order to determine the activity and properties of the heterogeneous catalysts produced from the $Fe(CO)_5$ TMC precursors. Reactor studies showed that catalyst concentrations as low as 1% Fe added as $Fe(CO)_5$, increased conversions of Illinois No. 6 coal from 39% to 80%. H/C ratio and pentane-soluble fraction of the product were not increased with catalyst addition indicating that the iron catalyst is not quite so active for hydrogenation as it is for coal conversion. The fraction of aromatic carbon in the coprocessing product increased due to higher conversion of the coal in the coal/oil (25:75 weight percent) mixture as a result of using $Fe(CO)_5$ at above 400°C. Catalyst compositions and dispersions were investigated at various stages along the reaction pathway using X-ray diffraction of the methylene chloride insoluble fraction of the reaction product. Plans for future work are also described.

51631 (DOE/PC/88806–T1, pp. 23-36) **Liquefaction research in pyrolysis, catalysis and coal dissolution.** Bajura, R.A.; Dalal, N.S.; Jagodzinski, P.W.; Mintz, E.A.; Whiting, W.B.; Penn, J.H.; Seehra, M.S.; Stiller, A.H.; Zondlo, J.W.; Dadyburjor, D. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (USA). 1988. In *Cooperative research in coal liquefaction infratechnology and generic technology development. Quarterly report, May 1, 1988–July 31, 1988.* Order Number DE89003427. Available from NTIS, PC A05/MF A01.

This research consists of six projects whose objectives are: (1) to determine whether hydride accepting quinones enhance coal liquid yields; and, to determine the effect of water on the cleavage of radical anion related to the coal structure; (2) to identify types of free radicals and their densities for selected coals before and after grinding; and, to examine the relationship between free radical content and liquefaction yields; (3) to relate the free radical density of coals to their H/C ratio and maceral content and to their extraction behavior with NMP; (4) to expand the current data base to include the extraction behavior of a wider variety of US coals in N-methyl pyrrolidone; to study further the effect of temperature, particle size, and time on the extraction and determine whether or not a differential coal separation is being effected; to examine the potential for upgrading the deashed product via several hydrogenation techniques; and, to collect FTIR data on raw coals, extracts, and residues; (5) to develop a molecular model for fluid mixtures of very many components (so-called polydisperse or continuous mixtures) that can be used in process simulators for design and control of coal-conversion processes; to develop a mathematical algorithm for efficient calculation of polydisperse-mixture phase equilibria; and, to develop computer software to implement this algorithm; and (6) to investigate the use of solid residue from task (4) NMP extraction process as a disposable catalyst for hydrotreatment reactions using a model compound. The scope, status, and results of each project are described.

51632 (DOE/PC/88806–T1, pp. 37-45) **Enhanced reactivity and selectivity in coal liquefaction and co-processing systems: Cyclic olefins: New hydrogen donors for coal liquefaction.** Curtis, C.W.; Tarrer, A.R.; Guin, J.A. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (USA). 1988. In *Cooperative research in coal liquefaction infratechnology and generic technology development. Quarterly report, May 1, 1988–July 31, 1988.* Order Number DE89003427. Available from NTIS, PC A05/MF A01.

The objectives of this research are (1) to investigate the potential of cyclic olefins as new hydrogen donor compounds and (2) to evaluate the thermal and catalytic chemistry of cyclic olefins at coal liquefaction conditions. Typical cyclic olefins which will be studied are 1,4,5,8-tetrahydronaphthalene, 1,4-cyclohexadiene, and 1,4,5,8,9,10-hexahydroanthracene. A literature review investigating the chemistry and synthesis of cyclic olefins will be soon completed, the results of which will be reported in the next quarterly report. A brief overview of the proposed experimental work as well as the selection of the model chemical species is given in this paper.

51633 (DOE/PC/88806–T1, pp. 46-60) **Enhanced reactivity and selectivity in coal liquefaction and co-processing systems: Coprocessing and coal liquefaction with novel catalysts.** Curtis, C.W.; Tarrer, A.R.; Guin, J.A. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (USA). 1988. In *Cooperative research in coal liquefaction infratechnology and generic technology development. Quarterly report, May 1, 1988–July 31, 1988.* Order Number DE89003427. Available from NTIS, PC A05/MF A01.

A model was developed and applied to fit the experimental data obtained from coal-tetralin reactions. The model was based on several assumptions as follows: (1) all pores perfectly communicate with each other; (2) the catalyst pore size distribution is of two delta functions; (3) a first order irreversible reaction occurs; (4) the reactant, coal, is treated as one species of uniform molecular size; (5) the pentane-soluble oils yield fully represents catalyst activity. In order to further test the model and investigate the effects of pore structure on the catalyst activity, the authors are also performing sulfur removal experiments. The catalyst activity is expressed in terms of an ability to remove sulfur from reactants with high sulfur contents of ca. 7 wt.%. They have also performed an analysis of work done in the tubing bomb microreactor relating to important mass transfer and mixing phenomena. The details of the analysis are reported in the following sections.

51634 (DOE/PC/88806–T1, pp. 61-78) **Enhanced reactivity and selectivity in coal liquefaction and co-processing systems: Coal liquids modification for enhanced reactivity.** Curtis, C.W.; Tarrer, A.R.; Guin, J.A. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (USA). 1988. In *Cooperative research in coal liquefaction infratechnology and generic technology development. Quarterly report, May 1, 1988–July 31, 1988.* Order Number DE89003427. Available from NTIS, PC A05/MF A01.

During the past quarter, two parallel efforts have been undertaken. One has been focused on follow-up studies regarding the use of coal-derived material as an additive in asphalt pavement. The second effort has involved the design, construction, and evaluation of a new type of reactor in which to do reactivity studies - e.g. upgrading of fractions from which high heteroatomic material has been extracted for use as an asphalt additive. The latter study is discussed first, describing: reactor studies, effect of hydrogen partial pressure and temperature on catalyst activity/deactivation, high severity hydrogenation studies, and low severity hydrogenation studies. A review is then given of the study on the utility of low value liquefaction products as a high value additive.

51635 (DOE/PC/88806–T1, pp. 91) **Integrated/characterization/modeling approach: Low temperature depolymerization and liquefaction of premium US coal samples.** Shabtai, J.S. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (USA). 1988. In *Cooperative research in coal liquefaction infratechnology and generic technology development. Quarterly report, May 1, 1988–July 31, 1988.* Order Number DE89003427. Available from NTIS, PC A05/MF A01.

Pittsburgh #8 and Beulah Zap. Coals were subjected to low temperature depolymerization. The procedure consists essentially of the following sequential steps: (1) intercalation of the coal sample with catalytic amounts (5-20%) of $FeCl_3$, followed by mild hydrotreatment (HT) of the coal-$FeCl_3$ intercalate; (2) base-catalyzed depolymerization (BCD) of the product from step 1, under super-critical conditions; and (3) hydroprocessing (HPR) of the depolymerized product from the two preceding steps, using a sulfided 6Co8Mo catalyst. One to 2 g product samples from each step of the depolymerization procedure were prepared and submitted for NMR, MS, and FTIR analysis being performed under other tasks of the project. The depolymerized coal products obtained after the sequential HT and BCD steps (steps 1 and 2) were subjected to fractionation into oils, asphaltenes, and asphaltols. The optimal conditions for depolymerization of the Pittsburgh #8 coal and the Beulah Zap lignite are given. Under these conditions the total yield of depolymerized, THF-soluble product from the Pittsburgh #8 coal sample was 61.5 wt% (calculated on the starting MAF coal). In addition, the coal yielded 14.0 wt% of THF-soluble pre-extract bringing the total yield of solubilized product to 85.5 wt% (MAF basis). The depolymerized Pittsburgh #8 coal consisted of oils, 62.7; asphaltenes, 12.5; and asphaltols, 24.8 wt%. The fractions are presently being subjected to detailed structural analysis by the above mentioned methods. The total yield of depolymerized, THF-soluble Beulah Zap lignite 86.0 wt% (MAF basis), excluding an additional 3.8 wt% of THF-soluble pre-extract. The depolymerized lignite consisted of oils, 63.0; asphaltenes, 17.8; and asphaltols, 19.2 wt%.

51636 (DOE/PC/88806–T1, pp. 94-95) **Project integration and database development.** Huggins, F.; Ramamoorthy, S.; Shah, N.; Shah, A.; Huffman, G.; Francis, H.; Kagwade, S.; Mitra, S. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (USA). 1988. In *Cooperative research in coal liquefaction infratechnology and generic technology development. Quarterly report, May 1, 1988–July 31, 1988.* Order Number DE89003427. Available from NTIS, PC A05/MF A01.

The software for the Consortium for Fossil Fuel Liquefaction Science (CFFLS) network/database system was successfully transferred from the AT and T 3B20 computer in the School of Engineering to a Digital Equipment Corporation MicroVAX II computer in the Moessbauer/XAFS laboratory at the University of Kentucky. The major reason for this change was the anticipated phasing-out of the AT and T 3B20 computer, which is no longer being supported. The following minor enhancements have been added to the MicroVAX version: (1) a reply option has been included in the mail utility; (2) the file transfer procedures via Kermit or XMODEM protocols should be easier to follow; (3) it should be possible to access the CFFLS Network via ARPANET and UKNET, so that long distance charges can be avoided. In addition, procedures and techniques are being developed and refined for the analysis of mineral matter in CFFLS coals using computer-controlled scanning electron microscopy (CCSEM), Moessbauer spectroscopy and EXAFS spectroscopy in order to augment the CFFLS database on coal properties relevant to liquefaction. Most of the development has involved new software and hardware for the CCSEM. However, such procedures are for the most part now completed.

51637 (DOE/PC/88810–3) **Development of analytical procedures for coprocessing: Quarterly progress report, April 1–June 30, 1989.** Vogh, J.W.; Anderson, R.P. National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA). Aug 1989. 17p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88810. Order Number DE90001129. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This is the third quarterly technical report for a project designed to extend our understanding of coprocessing reactions. More specifically, this research is concerned with development of chemical analytical procedures needed to distinguish between materials and compound classes in the coprocessing products which are derived from the petroleum resid, the coal, or both. Carbon isotope ratios have been used to determine the relative contributions of coal and resid to various coprocessing fractions where the fractions were produced by distillation or solubility fractionation. In the current project, the carbon isotope technique will be utilized with chemical compound type fractionations which have been developed at NIPER. These separation techniques will be used initially with coprocessing samples produced in-house with a 2-liter batch autoclave. Materials selected for initial study were Maya >1000° F resid and Illinois No. 6 coal. Catalyst was introduced by aqueous impregnation of the coal with ammonium tetrathiomolybdate solution. Conditions for satisfactory conversion have been established and workup procedures have been developed. All runs at the selected loadings were completed this quarter. 3 refs., 6 figs., 8 tabs.

51638 (DOE/PC/88818–3) **Two-stage, close coupled catalytic liquefaction of coal: Third quarterly report, 1 April 1989–30 June 1989.** Comolli, A.G.; Johanson, E.S.; Panvelker, S.; Popper, G.A. Hydrocarbon Research, Inc., Lawrenceville, NJ (USA). Jul 1989. 18p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88818. Order Number DE90001407. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Activities in the second quarter of April 1 to June 30, 1989, on the two-stage close-coupled catalytic liquefaction of coal program are covered in this report. The tasks include laboratory and bench-scale testing and Technology Assessment. Details of modelling experiments being conducted on a microautoclave scale are reported and initial results from a Variable Volume Bench Run are presented. Also included are an update on Western Coal economics and scheduling changes. 8 figs., 4 tabs.

51639 (DOE/PC/88915–T4) **Steam gasification of carbon: Catalyst properties: Quarterly report, June 15, 1989–September 14, 1989.** Falconer, J.L.; Lauderback, L.L. Colorado Univ., Boulder, CO (USA). 25 Sep 1989. 7p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-88PC88915. Order Number DE90001223. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This research uses three techniques to study catalyzed gasification of carbon in an effort to determine the concentration of catalyst sites on a carbon surface and thus determine how effectively a catalyst is utilized for steam gasification. Both alkali and alkaline earth oxides are effective catalysts for accelerating the gasification rate of coal chars, but in many cases only a fraction of the catalyst is in a form that is effective for gasification. We will study the steam gasification of carbon in order to determine the concentration of active catalyst sites, the composition of the catalyst, and the location of the catalyst on the surface. Transient isotope tracing (switching reactant feed gases between $H_2{}^{16}O$ and $H_2{}^{18}O$) will be used to measure the concentration of sites at steady-state reaction conditions. A steady flow of $H_2{}^{16}O$ in He will be replaced by $H_2{}^{18}O$ in He, while maintaining the same reaction rate, and the change in product signals will be detected with a computer-controlled mass spectrometer. Secondary ion mass spectrometry (SIMS) will be used for both high surface area samples of carbon/carbonate mixtures that are heated in steam to various temperatures and for model surfaces with deposited ions. SIMS will provide a direct measurement of surface composition. Scanning tunneling microscopy (STM), a technique that provides atomic resolution images of surfaces, will be used to determine catalyst dispersion and the location of catalyst on the surface. The interrelation of the results from these techniques (for potassium and calcium catalysts) will provide knowledge of catalyst dispersion, composition, and utilization.

51640 (DOE/PC/88919–T2) **Bioprocessing of lignite coals using reductive microorganisms: Progress report number one, September 30, 1988–February 1, 1989.** Crawford, D.L. Idaho Univ., Moscow, ID (USA). Dept. of Bacteriology and Biochemistry. 1989. 5p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-88PC88919. Order Number DE90001082. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A major goal of this project is to isolate unique microbial strains that catalyze a variety of biochemical transformations of low molecular weight coal substructure model compounds and then to determine if these strains will carry out similar reactions with coal. We have several enrichments underway using suitable model compounds such as pyrogallol (2,3-dihydroxyphenol) and gallic acid (3,4,5-trihydroxybenzoic acid) to isolate organisms that reductively dehydroxylate phenolic hydroxyl groups. We are also using various naphthoquinone and antrhaquinone dyes as substrates in isolation procedures. The most promising results so far are with hydroxynaphthoquinone. The purple non-sulfur bacteria belonging to the genus Rhodobacter are also of interest to us because some of them

degrade numerous aromatic compounds by way of reductive pathways. In addition, Rhodobacter species are not sensitive to air. Thus far, enrichment cultures with benzoate have yielded two isolates. Lowering the carboxyl content of lignite coal has been suggested as one means of improving its fuel value. We have isolated a bacterium from soil, tentatively identified as a Bacillus species, that nonoxidatively decarboxylates vanillic acid to guaicol. This bacterium also decarboxylated p-hydroxycinnimates to p-hydroxystyrenes. We are now attempting to get measurable decarboxylation of base-solubilized Vermont lignite coal using this organism. 1 tab.

51641 (DOE/PC/90534–13) **Supercritical fluid chromatography/supersonic jet spectroscopy: Progress report, June 1, 1989–September 15, 1989.** Goates, S.R.; Lee, M.L. Brigham Young Univ., Provo, UT (USA). Dept. of Chemistry. 1989. 7p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-86PC90534. Order Number DE90001378. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Recent accomplishments have included construction and testing of a new design of pulsed supersonic jet nozzle and characterization of the sheath flow nozzle. Good spectroscopic results were obtained with the pulsed nozzle, and it shows promise for capillary chromatography, but the design must still be improved. Study of the sheath-flow nozzle has illuminated some of the factors governing its behavior, and should help us further optimize its performance with capillary SFC/SJS. Swirl flow patterns may be the cause of the current high pressure limit in its use. Changes in the design of our collection optics have also been studied to see if sensitivity could be enhanced for dispersed fluorescence detection with a photodiode array. A major overhaul and upgrade of the excimer laser have aided our work and resulted in improved signal-to-noise in our measurements. 1 ref., 3 figs.

51642 (Juel-Conf–64, pp. 1-13) **Preparation of synthesis gases for alcohol synthesis.** Fedders, H.; Riensche, E. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente. Sep 1988. (In German). In *Working report of the Institute of Reactor Components at the KFA Juelich. Scientific lectures of the commemorative colloquium held on September 2, 1987 at the KFA Juelich.* Order Number DE90711187. Available from NTIS (US Sales Only), PC A06/MF A01.

There are special requirements to be met by synthesis gases for the synthesis of methanol and higher alcohols. What we want to obtain is a stoichiometric gas composition for alcoholization. This is characterized by relatively low H_2/CO ratios. To prepare energy alcohols with various methods, H_2/CO ratios must be established approximately between 0.5 and 2, depending on the reaction classes of alcoholization required (H_2 or CO_2 as a coproduct). Moreover, it is advantageous to have as low a proportion of inert gases as possible. Process-engineering means of improving the overall system are determined with the help of thermodynamic calculations of individual partial processes which take into account the reciprocal influences of the partial processes involved. For the further development of the steam reforming process and the gas treatment, the development potential is first defined in laboratory tests. Laboratory experiments with positive results require subsequent testing on a pilot scale. (orig./EF).

51643 (Juel-Conf–64, pp. 14-25) **From synthesis gases to energy alcohols.** Hoehlein, B.; Doetsch, H.; Hammeke, K. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente. Sep 1988. (In German). In *Working report of the Institute of Reactor Components at the KFA Juelich. Scientific lectures of the commemorative colloquium held on September 2, 1987 at the KFA Juelich.* Order Number DE90711187. Available from NTIS (US Sales Only), PC A06/MF A01.

The Institute for Reactor Components of the Juelich Nuclear Research Station, in cooperation with the team for systems research and technological development, is studying the possibilities of integrating energy alcohols in power supply systems. In particular, the study deals with special issues ranging from primary energy carriers to logistics; it analyzes technical data experimentally, and points out solutions with respect to the future requirements of our society. (orig./EF).

51644 (NEDOJ–8809, pp. 3-5) **Outline of development of coal liquefaction and gasification.** Hinoyama, Hiroaki (New Energy Development and Industrial Technology Organization, Tokyo (Japan)). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the 8th NEDO General Assembly.* Available from NTIS (US Sales Only), PC A23/MF A01.

The outline of projects for coal liquefaction and gasification technologies are introduced. Development of the NEDOL process is the target for the technological development of bituminous coal. In 1987, study for the details of 250tons/day pilot plant was nearly completed. The target for brown coal liquefaction technology is the optimum liquefaction process for Australian brown coal. Integrated test operation was carried out in 1987 for the system in which the primary and secondary hydrogenation systems were linked together. In the technological development of hydrogen production from coal, most of the installation works were completed in 1987 except those for gasification process and electrical instrumentation facilities. In regard to the development of power generation technology by entrained bed coal gasification, research and development for a pilot plant started in 1986, detailed design of the facilities were worked out in 1987, and the production of a part of the facilities launched. As regards power generation technology of low calory gasification, basic design of the plant, cold model tests for the collection of design data, etc. were carried out.

51645 (NEDOJ–8809, pp. 53-73) **Development of low calorific gasification power generation technology (fluidized bed).** Fujisawa, Yoshiyuki (Electric Power Development Co., Ltd., Tokyo (Japan)). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the 8th NEDO General Assembly.* Available from NTIS (US Sales Only), PC A23/MF A01.

The objective of this project is to work out a basic design and perform cold model tests to collect design data needed for the development of coal gasification combined cycle power generation plant having the capacity of 1,000 t/d processing and 100 MW output. The basic design and history of cold model tests of the coal gasification furnace carried out during 1980 to 1986 as well as the overall structure of the plant and process are summarized. The main facilities are coal gasification facility, high temperature recovery system, dry desulfurization facility, precision dust removal device, and wet desulfurization facility, whose specifications, strutures, functions, etc. are breifly explained. Variable pressure operation method was employed for the calculation of the performance of the plant. For the partial load performance calculation, 4 kinds of loads, 100, 83, 67, and 50%, were adopted. Plant performance for each load under dry and wet gas refining is shown. Each facility was adjusted to match others, and the manual for the starting and stopping of the system was prepared. Start-Stop schecule is shown. 4 figures, 3 tables.

51646 (NEDOJ–8809, pp. 6-17) **Technological development of brown coal liquefaction. Current status of Australian brown coal project.** Kunii, Kazusuke (Nippon Brown Coal Liquefaction Co., Ltd., Tokyo (Japan)). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the8th NEDO General Assembly.* Available from NTIS (US Sales Only), PC A23/MF A01.

Operational research of a 150 t/day pilot plant for brown coal has been carried on at Morwell District in Victoria State, Australia. The history of the project, 2-step hydrogenation process for brown coal liquefaction, and the outline of the pilot plant are introduced. Reports are made on the first to the third operations concerning operator training; study and improvement of operational technique; safety confirmation of facilities; detection, repair and remodeling of defective parts; and the result of overhaul inspection at periodic maintenance. Reports are made on the fourth and fifth operations. How to get Australian employees required for the operation of the pilot plant seems to be a vital problem. Through harmony with the community, this project has been making contribution to the cultural relationship between Austraria and Japan. Making the most of the technology and knowhow obtained in the past 5 operations, full-scale operations will be made in the Run 6 and thereafter. 2 figures.

51647 (NEDOJ–8809, pp. 18-30) **Development of bituminous coal liquefaction technology. Progress of research and**

development by 1 t/d PSU. Murakami, Hisashi (Mitsui SRC Development Co., Ltd., Tokyo (Japan)). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the 8th NEDO General Assembly.* Available from NTIS (US Sales Only), PC A23/MF A01.

Reports are made on the construction and test operations of the NEDOL 1 t/d PSU system which were carried out up to 1987. The outlines of the design and construction work are introduced. In connection with the preparatory works, reports on preparation of the operational study plan and training of operators are presented. The test operation started in October, 1987 for the entire facilites of the PSU. In 1987, confirmation tests were made for the conveyance capability of conveyors, sensitivity of metal detectors, crusher capacity, etc. short loop tests, test operation of nitrogen gas and cold oil circulation were carried out to confirm the fuctions. Ways for carrying out safe and smooth research and development operations by PSU were studied. Summarized reports are made on the procedures for government agencies, construction of PSU, smooth promotion of test running, promotion of effective research, and subjects of operational study for 1988. 6 figures.

51648 (NEDOJ–8809, pp. 31-52) **Development of common basic technology. Development of coal liquid upgrading and oil mixing technologies.** Iemura, Yoichi (Research Association for Petroleum Alternatives Development, RAPAD, Tokyo (Japan)). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the 8th NEDO General Assembly.* Available from NTIS (US Sales Only), PC A23/MF A01.

The objective of this project is to develop upgrading technology for reforming the quality of coal liquid to become as good as that of petroleum products by the removal of impurity in coal liquid, and mixing technology of coal liquid with petroleum in order to investigate the optimum system for commercial plants. The result of the first stage development up to 1987 is reported. Hydrogenation experiments were carried out using commercially available catalysts with liquid oil only, or liquid oil mixed with petroleum, to investigate methods which will enable refining utilizing the facilities at existing oil refineries. Results of studies are reported on the hydrogenation refining of naphthane, kerosene and light oil distillates, and the hydrocracking of middle and heavy oils. As to the study on petroleum mixing technology and applicability, results of evaluation of characteristics and practicability as gasoline, and combustion tests of refined oil with heaters, diesel engines, and burners are reported. Reports are made also on the result of capability tests and the effects of additives. 21 figures, 10 tables.

51649 (NEDOJ–8809, pp. 74-89) **Development of hydrogen production technology. Utilizing coal research and development of material for gasifier.** Fukui, Hiroshi (Hitachi Ltd., Tokyo (Japan)). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the 8th NEDO General Assembly.* Available from NTIS (US Sales Only), PC A23/MF A01.

The objective of this research is to develop and evaluate new materials for gasifer refractories, ceramics, and metals used inside the gasifier which can withstand severe processing environment, for the purpose of supporting the development of gasification technology by a pilot plant. Characteristics of the gasifier and processing environment inside the gasifier are shown. Because the gasifer, which is the core of the plant, is scheduled to be designed and manufactured in 1988, the results of material development made up to the present were summarized at the end of 1987 for the selection and proposal of gasification materials. Major result obtained by now and the details of the proposal for materials are introduced. In connection with the development of refractories, studies were made on the problems about gasifier refractory materials, search for promising composition, development of materials, and slug-resistance of the developed materials. Descriptions are made about the establishment of water-cooled fireproofing wall construction method, development of ceramics for thermowell, selection of ceramics for valve seat, and evaluation of corrosion resistivity of metal materials. 12 figures, 5 tables.

51650 (ORNL/Sub–82-22239-01) **Deformation and fracture of low alloy steels at high temperature: Final report, May 1, 1982–April 30, 1985.** Marriott, D.L.; Stubbins, J.F.; Leckie, F.A.; Muddle, B. Oak Ridge National Lab., TN (USA). Dec 1988. 118p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC05-84OR21400. 19X-22239WBS Element U1-3.3. (UILU-ENG–88-4019). Order Number DE90001274. Available from NTIS, PC A09/MF A01 - OSTI; GPO Dep.

This project formed part of the initiative in the AR&TD program to characterize high temperature, time-dependent damage processes in low alloy steels, for use in the construction of coal-gasification plant. This project was broadly aimed at adding to the knowledge base for this bainitic form of 2.25Cr 1Mo steel, as it related to time-dependent performance at elevated temperature. Its original intention was to obtain information in specific grades of 2.25Cr 1Mo steel, in particular those containing reduced residual elements and microalloyed modifications, which were being considered as candidate materials at the time. This objective was subsequently modified, in the course of the contract period, to a more generic study of bainitic steel, using the 2.25Cr 1Mo material as a representative of the class. The main thrust of the project was directed initially at the detrimental effect of cyclic loading on creep resistance and manifesting itself in an apparently severe creep-fatigue interaction. Three subtasks were eventually identified. These are: a study of the evolution of microstructural changes in bainitic materials during steady load creep and under constant amplitude cyclic deformation, investigation of the effect of cyclic softening on the fatigue and creep strength of complex geometries, focusing on circumferentially notched bars, and investigation of the influence of environment as a possible cause of observed fatigue/elevated temperature interaction through its effects on crack initiation and propagation, using EDM notched specimens tested in air and vacuum. Results are discussed. 24 refs., 40 figs., 5 tabs.

51651 (ORNL/Sub–85-55904/1) **Development of a design methodology for high-temperature cyclic application of materials which experience cyclic softening.** Leckie, F.A.; Marriott, D.L.; Stubbins, J.F.; Handrock, J.L.; Kschinka, B. Illinois Univ., Urbana, IL (USA). Dept. of Mechanical and Industrial Engineering. Aug 1987. 72p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC05-84OR21400. (UILU-ENG–88-4011). Order Number DE90001585. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The project described in this report has, as its beginning, two investigations, the first a study of the effect of material softening on the overall structural stability of complex components, and the second an evaluation of damage induced through cyclic loads combined with high temperature environmental effects. The initial work was carried out on one grade of 2.25Cr 1Mo steel, with the intention of extending the investigation to other grades once the investigative techniques had been settled. However, considerable interest has grown in the application of modified forms of austenitic steel to very high temperature use in superheaters and reheaters. The ability to utilize these materials can mean an increase of 100°C in the top temperature in a power plant, which converts into a significant improvement in thermal efficiency for a very small investment in material. Therefore, the direction of this project has been modified to continue on this class rather than the ferritic alloys originally under consideration. The basic problem to be investigated in the austenitics is the concern for possible strength variations, either positive or negative, induced in the very complex microstructures by service conditions of cyclic load and high temperature. 23 refs., 31 figs., 6 tabs.

51652 (ORNL/Sub–88-SB775/01) **Literature review of workability and phase stability relative to advanced austenitic alloys in steam service.** Domian, H.A.; LeBeau, S.E. Oak Ridge National Lab., TN (USA); Babcock and Wilcox Co., Alliance, OH (USA). 15 Aug 1989. 21p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC05-84OR21400. MMES-72X-SB775C; B&W-CRD-1207. Order Number DE90001276. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A literature search was performed to determine the effects of chemical composition on the workability and phase stability of four candidate austenitic alloys being developed by ORNL for application in advanced steam cycle superheaters and reheaters. These alloys

are expected to be fully austenitic and therefore may be susceptible to hot cracking upon casting, hot working and welding. Otherwise the alloys are expected to be equal to or better than TP 316 stainless steel in cold workability and phase stability. 79 refs., 5 figs., 6 tabs.

51653 (PB–89-214019/XAB) **Characterization of MGP (manufactured gas plant) residues using proposed RCRA (Resource Conservation Recovery Act) tests. Topical report, May 1987-February 1989. Final report.** Lew, L.R.; Gould, J.E. Atlantic Environmental Services, Inc., Colchester, CT (USA). Mar 1989. 100p. Available from NTIS, PC A05/MF A01.

The U.S. Environment Protection Agency (EPA) has proposed two tests that may affect the regulation of residues associated with manufactured gas plant (MGP) sites which are not currently regulated by the Resource Conservation Recovery Act (RCRA): the Toxicity Characteristic Leaching Procedure (TCLP) and a revised reactivity test which includes interim guidance levels for reactive cyanide and sulfide as well as methods for determining reactive levels. Atlantic Environmental Services, Inc, carried out a research project under the Gas Research Institute program for the management of MGP sites. Several samples were tested using the proposed TCLP to determine the likelihood that MGP residues would be characterized as RCRA wastes under the new procedures. The reactivity tests for cyanide and sulfide also were run on samples collected from MGP sites to determine whether these specific residues would fall based on the revised technique. The results of the study are presented.

51654 (PB–89-214050/XAB) **Fuel-use options for the management of MGP (manufactured gas plant) site wastes. Topical report, June-December 1987.** Bratina, J.E.; Odenthal, W.A. Remediation Technologies, Inc., Pittsburgh, PA (USA). Feb 1989. 42p. Available from NTIS, PC A03/MF A01.

This report presents the results of a study to evaluate the potential of fuel-use options for the management of selected Manufactured Gas Plant (MGP) site wastes. Candidate fuel-use technologies are identified and their application to the primary categories of MGP site wastes are reviewed. A field demonstration program is described which was executed to evaluate the production of liquid fuels from two samples of MGP site hydrocarbons and contaminated soils. The report summarizes the identification, selection, and acquisition of wastes for the demonstration program, describes the technology used to produce the fuels, presents the characteristics of the final liquid product, and identifies potential end users for the product fuel. The report concludes with an integrated technical and economic analysis of the fuel-use options.

51655 **A model for cavity growth and resource recovery during underground coal gasification.** Britten, J.A. (Lawrence Livermore National Lab., CA (USA)); Thorsness, C.B. *In Situ (USA)*, 13(1): 1-54 (1989).

A model describing cavity growth and gas production during underground coal gasification (UCG) has been developed. It is applicable to UCG of shrinking coals in which oxidant injection is maintained at a fixed point low in the coal seam. It is based on a few fundamental assumptions; namely that the cavity is axisymmetric about the injection point, all resistance to injected gas flow is through ash and overburden rubble that accumulates on the cavity floor, thermal radiation dominates in the well-mixed void space, and the coal and overburden spall or rubblize on a small scale du to parameterized thermal effects. The model calculates water influx from the coal aquifer, flow dispersion trough the rubble piles, radiant and convective heat transfer, gas/solid, gas-phase and simple pyrolysis reactions to calculate, through mass and energy balances, recession rates of cavity surfaces and generation rates of major product species. Model predictions are shown to compare very well with process and geometrical data from two UCG field tests, and the model is used to simulate UCG Of other coals of UCG interest.

51656 **Determination of sulfide in spent caustic solutions from the chemical cleaning of coal.** Richardson, R.G. (Iowa State University (USA). Ames Laboratory Fossil Energy Program); Chriswell, C.D.; Markuszewski, R. *Fuel Processing Technology (Netherlands)*, 22(3): 217-226 (Jul 1989).

Chemical cleaning of coal by the molten caustic leaching process results in the recovery of a spent caustic stream which contains a complex mixture of inorganic and organic salts. Determination of sulfur forms in this matrix is required to elucidate the mechanisms of sulfur removal and carbonate formation during molten caustic leaching. Since the sulfide present in spent caustic is quickly oxidized to sulfate, the method for sulfide must be rapid in order to yield meaningful results about the mechanisms of caustic desulfurization of coal. Thus, a rapid method has been developed for the determination of sulfide in such a caustic matrix. In this method, samples are acidified and purged with nitrogen gas to isolate hydrogen sulfide. The hydrogen sulfide is then either trapped in a solution of lead acetate and total sulfur determined in the resulting precipitate, or the hydrogen sulfide is trapped by a resin impregnated with lead acetate and packed in a calibrated tube. In the latter variant, sulfur concentration determination is based upon the length of the resin bed in the tube that is blackened by the formation of lead sulfide. 18 refs., 1 fig., 3 tabs.

51657 **A new method for estimation of activation energies associated with coal gasification.** Raghunathan, K. (West Virginia Univ., Morgantown (USA)); Yang, R.Y.K. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA)*, 32(1): 478-485 (1987). DOE Contract AC21-83MC20320. (CONF-8704353–: American Chemical Society Division of Fuel Chemistry, Denver, CO (USA), 5-10 Apr 1987).

Kinetic studies of coal gasification and pyrolysis are important in the design and operation of gasification plants. In many of these studies, weight loss of a coal sample is continuously recorded, with a TGA for example, to produce conversion versus time data for a specific set of experimental conditions. Theoretical and empirical models are frequently used to represent those primary kinetic data. With a proper representation of the conversion data, other secondary kinetic data such as half-life and reactivity are evaluated. Characterization of coal, development of proper reaction rate models and estimation of its activation energy follow. Mahajan et al. (1978) found that when the char conversion is plotted as a function of a dimensionless time τ, defined by $\tau = t/t_{\frac{1}{2}}$, where $t_{\frac{1}{2}}$ is the half-life of the reaction, gasification data for widely different experimental conditions can be represented by a single x versus τ curve. This unification approach has been used and confirmed by a number of researchers, e.g., Kasaoka et al. (1985) and Peng et al. (1986). In this work the authors use the unification approach as they basis to develop a theoretical relation between half-life and average reactivity which is then verified experimentally. The relation in turn leads to the development of simple and practical alternative for estimating the apparent activation energies of coal gasification and other types of reactions.

51658 **The chemical basis for removal of organic sulfur from coal via JPL (Jet Propulsion Laboratory) chlorinolysis.** Aida, T. (Iowa State Univ., Ames (USA)); Venier, C.G.; Squires, T.G. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA)*, 32(1): 486-491 (1987). (CONF-8704353–: American Chemical Society Division of Fuel Chemistry, Denver, CO (USA), 5-10 Apr 1987).

While it seems obvious that investigation of the chemistry of coal desulfurization is necessary to develop more efficient and economical processes, this important research area has received little attention. For example, Chlorinolysis was investigated by the Jet Propulsion Laboratory (JPL) more than ten years ago and reported to remove up to 60% of the organic sulfur. Yet the chemical pathway by which organic sulfur is removed is still unknown. The authors have investigated the behavior of various organic sulfur functional groups under JPL Chlorinolysis conditions ($Cl_2/CH_3CCl_3/H_2O$) in order to elucidate the major desulfurization pathways. They have also looked at undesirable chlorination side reactions and have briefly examined conditions which minimize the ratio of chlorination to desulfurization.

0105 By-products

Refer also to citation(s) 51634

0106 Properties

Refer also to citation(s) 51619, 51623, 51631, 51636, 51685

51659 (DOE/PC/79905–T8) **Fundamental research on surface science of coal in support of physical beneficiation of coal: Quarterly technical progress report No. 7, April 1–June 30, 1989.** Good, R.J.; Keller, D.V. Jr. State Univ. of New York, Buffalo, NY (USA). Dept. of Chemical Engineering. [1989]. 47p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-87PC79905. Order Number DE90001161. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The following areas of study are reported: (1) The contact angle study on microscopic surfaces of ground coal, using the decane-water interface, has been extended to two high volatile-B-bituminous coals, from the Taggart and Blue Gem seams. The contact angles on the two new coals were grouped around three different and very distinct mean values, of around 33°, 62° and 103°, for both coals; (2) The effect on contact angles, of surface oxidation by exposure to ambient atmosphere for up to 160 days, on Upper Freeport (Mvb) and Illinois No. 6 (HvCb) coals; (3) Aromaticity measurements on 4 coals, ranging in rank from high volatile a bituminous to anthracite, performed using solid state ^{13}C N.M.R.; (4) Contact angle measurements of liquid-gas interfaces on polished surfaces of 14 different coals, ranging in rank from lignite to anthracite were made using the captive drop technique, with water, glycerol and diodomethane; (5) Adsorption of octanol from decane as compared with that of cyclophexanol from decane, on two coals, Illinois No. 6 (HvCb) and Upper Freeport (Mvb); (6) Samples Illinois No. 6 (HvCb) and Kentucky No. 9 (HvCb) before and after processing were characterized by ESCA and FTIR. The FTIR and EC analysis revealed that, as expected, there was a decrease in the pyrite and mineral components of these coals. The FTIR results showed the amount of carbonyl and carbonate species deceases, when the coals were processed. 10 refs., 17 figs., 11 tabs.

51660 (DOE/PC/88806–T1, pp. 80-81) **Integrated/characterization/modeling approach: Coal structure/liquefaction yield correlation by means of advanced NMR techniques.** Pugmire, R.J. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (USA). 1988. In *Cooperative research in coal liquefaction infratechnology and generic technology development. Quarterly report, May 1, 1988–July 31, 1988.* Order Number DE89003427. Available from NTIS, PC A05/MF A01.

A study was undertaken in two areas; (1) maceral separation and (2) development of high resolution ^{1}H and ^{13}C NMR techniques in the study of complex fuel mixtures. The author has developed a procedure that combines the DGC (density gradient centrifugation) method for initial characterization together with a chemical comminution procedure to enhance maceral separation. While this procedure may not always provide maceral concentrates with the purity levels found in DGC samples, the method has been used to obtain maceral groups (liptinite, vitrinite, and inertinite) in large quantities (approx. 10g). Modern high field NMR spectroscopic techniques have been evaluated in order to assess the capabilities of such techniques for the study of coal derived liquids (CDL) and other related materials. The utility and quantitative aspects of spectral editing techniques have been evaluated. The DEPT method is one of the more attractive spectral editing pulse sequences but the quantitative aspects of all such editing procedures are quite poor. A combination of the heteronuclear correlation, J-coupled, and INADEQUATE 2-D experiments prove to be a very powerful combination of techniques for identifying all of the major structural types and fragments in the JP-4, JP-5 and MIG-25 fuels and work is now underway to implement these techniques for the study of CDL's. The author has completed the software development for analysis of the 2-D INADEQUATE data on model compounds and will work through a series of model compounds in order to prove the reliability of the analysis algorithms before beginning extensive analysis of coal extracts and pyrolysis tars.

51661 (DOE/PC/88806–T1, pp. 81-87) **Integrated/characterization/modeling approach: Mass spectrometric investigation of coal pyrolysis mechanisms and kinetics.** Meuzelaar, H.L.C. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (USA). 1988. In *Cooperative research in coal liquefaction infratechnology and generic technology development. Quarterly report, May 1, 1988–July 31, 1988.* Order Number DE89003427. Available from NTIS, PC A05/MF A01.

Samples from other projects in this study were analyzed by Curie-point pyrolysis/desorption mass spectrometry using suspensions in methanol or solutions in methylene chloride. In the oil fraction pyrolyzate alkyl phenols, alkyl naphthalenes and BHT (dibutyl hydroxy toluene; a commonly used stabilizer in THF) were the major compounds. The origin of the BHT is obscure, since the THF-soluble and -insoluble samples did not contain it. Moreover, a sample of the distilled THF that was used in the process tested negative for the presence of BHT. Alkylnaphthalenes and phenols were also seen in the asphaltenes, as well as a major peak at m/z 170. The asphaltols principally contained alkyl phenols. Curie-point pyrolysis/desorption GC/MS was performed to confirm peak assignments and to check solvent purity. In the oil fraction, several alkyl substituted phenols were seen, as well as diphenyl ether (molecular ion m/z 170), and bi-cyclohexyl peaks. The asphaltenes also contained large amounts of diphenyl ether. Results are shown.

51662 (DOE/PC/88806–T1, pp. 88) **Integrated/characterization/modeling approach: Fourier transform IR and chromatographic studies in coal liquefaction chemistry.** Eyring, E.M. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (USA). 1988. In *Cooperative research in coal liquefaction infratechnology and generic technology development. Quarterly report, May 1, 1988–July 31, 1988.* Order Number DE89003427. Available from NTIS, PC A05/MF A01.

Samples from another project in this study were analyzed by diffuse reflectance on a Digilab FTS 40. The fractions of aromatic carbon (fa) were calculated by Brown's method using relative intensity of the aromatic C-H band (3030 cm −1) to that of the aliphatic C-H band (~ 2940 cm −1). The base catalyzed depolymerization (BCD)-Asphaltols sample has a higher fa value (0.77) than those of other analyzed samples. Coal typically exhibits three infrared bands centered near 850, 810, and 750 cm−1. It is believed that the integrated intensities of these three observation coupled with the fact that BCD-Asphaltols sample has a higher fa value suggests that the samples (BCD-Asphaltols) are more aromatic and contain the larger polynuclear condensed aromatic ring systems. In order to yield a higher conversion to liquids, the production of BCD-Asphaltols should be suppressed during the coal liquefaction process. Some Wyodak coal (> 100 mesh) was extracted with THF. Samples of approximately one gram were impregnated with $ZnCl_2$ from a methanolic solution using a supersonic bath to enhance impregnation. The impregnated samples were heated to 305°c in a glass-lined tubing bomb reactor. Following quenching, the impregnated samples were examined at mid-infrared wavelengths using a Digilab DTS-40 FT-IR spectrometer. Difference mid-infrared spectra obtained between 1600 cm^{-1} and 1000 cm^{-1} suggested that some aromatic ether bonds in the coal had been broken. Similar experiments were carried out with Wyodak coal and $FeCl_3$ and $CrCl_3$. The latter inorganic salts appear from the infrared spectra to effect greater depolymerization of Wyodak coal for the same reaction time (90 minutes) and temperature (305°C).

51663 (DOE/PC/88806–T1, pp. 89-90) **Integrated/characterization/modeling approach: Solvent extraction and ultrasonic extraction correlations to pyrolysis data.** Anderson, L.L. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (USA). 1988. In *Cooperative research in coal liquefaction infratechnology and generic technology development. Quarterly report, May 1, 1988–July 31, 1988.* Order Number DE89003427. Available from NTIS, PC A05/MF A01.

Wyodak, Pittsburgh #8 and Illinois #6 coals have been studied. The liquefaction processes used are solvent extraction (Soxhlet) and pyrolysis at low temperature in a tubing bomb reactor heated by a fluidized sand bath. The optimum conditions, as determined by their prior studies in other coals, are 350°C, 3 hours, 1 atm (cold) of nitrogen gas, no solvent or catalyst added. The proximate, ultimate and maceral analyses are shown. The distribution of solvent extraction and pyrolysis products of the three coals is also shown. Correlation of properties and yields of the various products is underway. For more complete characterization of the liquefaction

products from both pyrolysis and solvent extraction, a supercritical fluid chromatography system has been purchased and installed. Preliminary runs only have been made up until now, but when calibration runs are complete, the liquefaction products and their fractions will be analyzed. Additional coals will be studied to provide further information on the influence of composition, rank, etc., on liquefaction behavior by differential liquefaction processing.

51664 (DOE/PC/88806–T1, pp. 92-93) **Basic process/ resource evaluation task.** Davis, B.H. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (USA). 1988. In *Cooperative research in coal liquefaction infratechnology and generic technology development. Quarterly report, May 1, 1988–July 31, 1988.* Order Number DE89003427. Available from NTIS, PC A05/MF A01.

This study consists of four projects whose objectives are: (1) to collect and characterize coals from Western Kentucky; (2) the direct liquefaction of collected coals; (3) a detailed product characterization of selected coals; and (4) to establish relationships relating coal properties to direct liquefaction yields. The scope of each project and results to date from the first two projects are summarized.

51665 (DOE/PC/88924–4) **Thermodynamics of the solvent swelling of coal: Technical progress report No. 4, June 1, 1989–August 31, 1989.** Green, T.K. Western Kentucky Univ., Bowling Green, KY (USA). Center for Coal Science. 1989. 18p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-88PC88924. Order Number DE90001404. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The solubilities of the pyridine-extract and O-alkylated extracts of the Illinois No. 6 coal in liquid benzene were measured. The solubility increases with increasing size of the alkyl group. The number average molecular weights of the corresponding pyridine-insoluble residues were calculated using the Flory-Rehner equation and the interaction parameters determined on the extracts. 8 refs., 7 figs., 5 tabs.

51666 (DOE/PC/90502–12) **Catalyst accessibility in high volatile bituminous coal: Quarterly report.** Kispert, L.D. Alabama Univ., University, AL (USA). Dept. of Chemistry. Oct 1989. 8p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-86PC90502. Order Number DE90001462. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

As reported previously, an EPR technique has been developed in this lab to determine the pore size and number distribution in high volatile bituminous coal using nitroxide spin probes I-IX of different sizes, shapes and reactivity. We have studied pore size and shape distribution in Mary Lee, Black Creek and Pratt coal from Alabama, the Penn State Coals, PSOC No. 271, 137 and 669 as well as PSOC-1354 and PSOC-311 and Argonne Premium Coal Samples (APCS) No. 3, No. 4, No. 5, No. 6, and No. 8. These coals were studied because independent SANS, DRIFT and NMR relaxation studies related to pore size and shape distribution have been recently reported which substantiated our results. This quarter, five Argonne Premium Coal Samples (APCS); Illinois No. 6 (HVB), Pittsburgh No. 8 (HVB), Pocahontas (LVB), Utah Blind Canyon (HVB) and Beulah-Zap (LIG) were selected for EPR and ENDOR studies. Experiments were performed on undoped as well as spin-probe doped coals at 185 K and 120 K. Also EPR and ENDOR measurements, were made for toluene spin-probe solutions at 185 K and 120 K. ENDOR measurements with the magnetic field at the center of each coal EPR signal were also performed. 9 refs., 4 figs.

51667 (DOE/PC/90507–T12) **Surface properties of coal and their role in coal beneficiation: Technical progress report, June 15–September 14, 1989.** Fuerstenau, D.W. California Univ., Berkeley, CA (USA). Dept. of Materials Science and Mineral Engineering. Oct 1989. 3p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-86PC90507. Order Number DE90001156. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The main objective of this research has been to identify and characterize the properties of coal that determine its wetting characteristics and its behavior in surface-based coal cleaning processes. During the last quarter, we studied the effect of pH and ionic strength on the induction time and the zeta potential of as-received Cambria No. 78 and New Zealand coals. Included also was an investigation of the effect of particle size on the observed induction time of the two coals in sodium nitrate solutions. The effect of oxidation on the zeta potential of Cambria No. 78 and New Zealand coals in 0.002 M $NaNO_3$ solution was also investigated.

51668 (EPRI-ER–6099-SR, pp. 6.1-6.21) **Studies of the structure of biodegraded coal.** Bean, R.M. (Battelle, Pacific Northwest Lab., Richland, WA (USA)); Campbell, J.A.; Franz, J.A.; Linehan, J.C. Electric Power Research Inst., Palo Alto, CA (USA). Nov 1988. (CONF-8711252–: 1. EPRI workshop on coal structure, Monterey, CA (USA), 4-5 Nov 1987). In *1987 workshop on coal structure. Proceedings.* Order Number DE89004100. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Ever since Cohen and Gabriele (1982) published their paper on the biodegradation of leonardite coal by a fungus, Coriolus versicolor, there has been a good deal of research to define the scope of the phenomenon and to discover means for its commercial exploitation. Biodegraded, water-solubilized coal may be a useful feed for further upgrading by microbes (for example, desulfurization or denitrogenation). The product may be a suitable substrate for microbial methanation. It is even conceivable that the process may be used to recover coal from coal deposits otherwise uneconomical to mine. Regardless of its eventual economic disposition, the coal biosolubilization process represents a unique opportunity for the analytical chemist with an interest in coal structure. The ability to render coal water-soluble makes it possible to apply analytical procedures that are not applicable to macromolecular coal samples. In addition, since specific enzymatic mechanisms are at work in the degradation process, a knowledge of the biodegraded coal structure can be used to gain insight into the structure of the original coal substrate. This paper describes some of the procedures the authors are using to study the structure of biosolubilized coals and presents some of their early results.

51669 Characterization of mineral matter in sub-bituminous coals by AIA [automated image analysis]-SEM [scanning electron microscopy]. Straszheim, W.E. (Iowa State Univ., Ames (USA)); Yousling, J.G.; Younkin, K.A.; Markuszewski, R. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(1): 62-69 (1987). DOE Contract W-7405-ENG-82. (CONF-8704351–: Structure and properties of low rank coals, Denver, CO (USA), 5-10 Apr 1987).

Automated image analysis (AIA) was used with scanning electron microscopy (SEM) and energy-dispersive x-ray spectroscopy to characterize the mineral matter in two western sub-bituminous coals from the Adaville No. 11 seam (Kemmerer, WY) and the Dietz No. 1 and 2 seams (Decker, MT). The samples were ground to – 200 mesh and cleaned by float-sink separation at 1.40 and 1.38 sp. gr., respectively. The particles were characterized before and after cleaning for mineral phase and size distributions by classifying them into 6 sizes and 16 mineral categories. Quartz was the dominant mineral in both coals, with the Adaville sample containing primarily quartz and an iron-rich mineral. Traces of apatite were also detected in the Adaville samples. The Dietz coal contained primarily quartz and kaolinite. Preliminary results are also presented for the association of the mineral particles with the coal matrix. These analyses were performed by automatically classifying the composite mineral - coal features into 10 types of particles of increasing specific gravity. The results closely estimated the total mineral matter content, as calculated from the ASTM ash content, and the specific gravity distributions were consistent with data obtained from the cleaning step.

51670 Investigations of anodically oxidized coal. Lalvani, S.B. (Southern Illinois Univ., Carbondale (USA)). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(1): 107-117 (1987). (CONF-8704351–: Structure and properties of low rank coals, Denver, CO (USA), 5-10 Apr 1987).

A number of studies carried out on the electrolysis of coal in basic media support the conclusion that electroxidation of coal in NaOH forms soluble products similar to humic acids. Upon further electrolysis the humic acids - like material decomposes to liberate CO_2 at the anode. Hydrogen is liberated at the cathode with high efficiency and, depending upon the electrode potential and other conditions, relatively small amounts of O_2 and traces of CH_4 and C_2H_2 form at the anode. Different cell geometries have been explored, ranging from a stirred - cell reactor to a reactor with an anode made of anthracite coal; other electrodes which have been used include Pt,

graphite, Pb and Ni. The effect of catalysts, such as vanadium pentoxide and cobalt chloride, on the oxidation rates have also been studied. Some researchers reported that horizontal electrodes caused higher rates of coal conversion than vertical electrodes. The present study reports more details as to products formed during coal electrolysis in basic media and considers various possible reaction pathways for electrochemical oxidation of coal. Constant potentials were employed in this work and the reaction products were analyzed by FTIR, and for elemental compositions.

51671 Aliphatic structural elements of a Pocahontas No. 3 Coal. Stock, L.M. (Argonne National Laboratory, IL (USA). Chemistry Division); Shih-Hsien Wang. *Energy and Fuels (USA),* 3(4): 533-535 (Jul-Aug 1989).

Short communication. 12 refs., 1 fig., 1 tab. BITUMINOUS COAL/ structural chemical analysis; OXIDATION; RUTHENIUM OXIDES

51672 Characterization of coal macerals using combined chemical and NMR spectroscopic methods. Chol-yoo Choi (Argonne National Laboratory, IL (USA). Chemistry Division); Muntean, J.V.; Thompson, A.R.; Botto, R.E. *Energy and Fuels (USA),* 3(4): 528-533 (Jul-Aug 1989).

Resinite, sporinite, vitrinite, and inertinite macerals were separated from two high-volatile bituminous coals obtained from the Argonne Premium Coal Sample Program and one high-volatile bituminous coal from The Pennsylvania State University Coal Sample Bank. A survey of the chemical nature of these macerals was carried out by using chemical techniques in combination with solid ^{13}C NMR spectroscopy. Alkylation with ^{13}C-enriched methyl iodide followed by NMR analysis was used to determine the concentrations of acidic OH and CH sites in these materials. The hydroxyl and carboxylic acid contents of these macerals were also determined. 31 refs., 5 figs., 6 tabs.

0108 Waste Management

Refer also to citation(s) 51654, 51699, 52153

51673 (CRIE-T–87106) **Transport of solutes from coal ash through soil (Part 3). Effect on solute transport through soil of pH of interstitial water.** Sato, Kazuo. Central Research Inst. of Electric Power Industry, Komae, Tokyo (Japan). Energy and Environment Lab. Sep 1988. 36p. (In Japanese). Order Number DE89782316. Available from NTIS (US Sales Only), PC A03/MF A01.

The reclamation disposal of coal ashes from coal-fired power plants is interested in the influence of coal ash dissolution water on ground water and surrounding sea area. In order to estimate movement of solutes leached from coal ash in soil, solute transport models have been developed in this study. Most coal ashes produce alkaline leachates. This alkalinity is expected to be neutralized by the underlying, unsaturated soil layer during the infiltration of leachate. The models estimate the effect of pH of interstitial water on adsorption of solutes by soil, because the movement of solutes depend heavily on pH of that water. The results of soil-column experiments were analyzed using the models. Changes in pH of interstitial water due to neutralization did not cause changes in the infiltration velocity of B and SO_4-S through soil. Meanwhile, Mo was strongly affected by changes in pH and was concentrated around boundary surface in the column. Cr (VI) concentration of effluent did not increase when the alkaline leachate front reached the bottom of the column. The models well predicted these phenomena. 41 refs., 15 figs., 4 tabs.

51674 (CRIE-U–13) **Development of a new type compound cement using coal ash.** Aoyagi, Masao; Okuda, Toru; Ishihara, Yoshimi. Central Research Inst. of Electric Power Industry, Abiko, Chiba (Japan). Sep 1988. 93p. (In Japanese). Order Number DE89782325. Available from NTIS (US Sales Only), PC A05/MF A01.

All clay raw material for cement was replaced and cinker was burned in a practical furnace to utilize effectively a large amount of coal ash which is discharged from coal fired power stations. After coal ash was ground, the ash was mixed with blast furnace slag to prepare new type compound cements. Some tests were carried out after concrete was manufactured with these cements. Unburned coal in cement burns in the kiln, resulting in fuel cost saving. Fresh or set concrete showed equivalent or better characteristics. Cement mixed with 25% blast furnace slag can be used as the cement for stabilizing weak ground, cement with 45% blast furnace slag as conventional portland cement, and cement mixed with 65% as the cement for mass concrete. Four million tons of coal ash would annually be able to be utilized effectively, if this cement manufacturing would be carried out with industrial scale. 30 figs, 64 tabs.

51675 (DOE/PC/79918–T5) **Novel sorbents for coal conversion wastewater treatment: Quarterly report, March 16, 1989–June 15, 1989.** Fogler, H.S.; Srinivasan, K.R. Michigan Univ., Ann Arbor, MI (USA). Dept. of Chemical Engineering. 1989. 11p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-87PC79918. Order Number DE90000044. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report describes the results from the work done to extend our clay modification procedures to commercially available clays. These commercial clays are naturally occurring, inexpensive, and are of the mixed mineral types. A typical sample known as emathlite (EMAT) was initially chosen for study. Cetyl pyridinium chloride (CPC), a cationic surfactant was used as the modifying agent. It is shown that the preparation of CPC-modified commercial clays (CPC-EMAT) is a very simple, one-step process. Both granular and the powdered forms of EMAT were used. Adsorption of pentachlorophenol (PCP) on CPC-EMAT has been found to be as strong as it was on activated carbons. However, in the case of fluorene (FLE), activated carbons appear to be better by a factor of three or so. More importantly, it has been established that CPC-EMAT is equivalent to our earlier formulation, CPC-HYDAL-MONT, which was prepared by a two-step modification of research grade samples of Na-montmorillonite. Thus the work reported here may be regarded as the first step towards transforming clay-based adsorption technology into a suitable, commercially viable alternative to activated carbons. 11 refs., 3 tabs.

51676 (DOE/PC/88868–T2) **Characterization and modification of particulate properties to enhance filtration performance: Quarterly technical progress report, June 1989–August 1989.** Bush, P.V.; Snyder, T.R.; Robinson, M.S. Southern Research Inst., Birmingham, AL (USA). 18 Sep 1989. 21p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88868. (SRI-ENV–89-853-6666). Order Number DE90001467. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Work performed during this period included tests under Task 2 - Parametric Tests of Ashes and Fabrics, Task 3 - Survey of Methods to Modify Particle Filtration Properties, and Task 4 - Proof-of-Concept Tests of Methods to Modify Particle Filtration Properties. Task 2 parametric testing of the cohesive ash from the Tennessee Valley Authority's 160 MW Atmospheric Fluidized-Bed Combustor has begun during this quarter. Task 3 work is nearly complete, and has resulted in the evaluation and selection of conditioning agents for Task 4 testing. The literature review carried out under Task 3 has been presented in two parts in the last two quarterly reports. A comprehensive summary of the literature review will be issued under separate cover during the final reporting quarter. Proof-of-Concept tests under Task 4 have begun with the collection of mixtures of fine silica with Monticello and Scholz ashes in the Fabric Filter Sampling System (FFSS). Mixtures of Monticello ash with sodium bicarbonate and hydrated lime have also been collected. Task 4 testing has also included the evaluation of hydrated lime and Scholz dustcake ash as fabric precoat materials. 1 ref., 7 figs., 3 tabs.

51677 (EPRI-GS–6519) **Proceedings: Fourth symposium on integrated environmental control.** Electric Power Research Inst., Palo Alto, CA (USA). c Sep 1989. 523p. Sponsored by Electric Power Research Institute. (CONF-880326–: 4. symposium on integrated environmental control, Washington, DC (USA), 2-4 Mar 1988). Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The Fourth Symposium on Integrated Environmental Control consisted of approximately 35 technical papers in five sessions that addressed various aspects of integrated design of environmental controls for coal-fired power plants. An Introductory Session first described the motivation and need for integrated environmental control. Subsequent sessions address (a) Combined NO_x/SO_2 Control, (b)

Integrated Waste Management, (c) Integrated Design in Advanced Generation, and (d) Systems Design of Environmental Controls. These proceedings provide a unique view of environmental controls, considering them as interrelated operating systems, as opposed to a collection of individual components. This information can be used in assessing environmental control options for flue gas, waste water and solids management, and advanced power generation. Individual projects are processed separately for the data bases.

51678 (PB–89-208920/XAB) **Evaluation of FGD (flue gas desulfurization) dry-injection sorbents and additives. Volume 1. Development of high reactivity sorbents. Final report, January 1986-December 1987.** Jozewicz, W.; Chang, J.C.S. Acurex Corp., Research Triangle Park, NC (USA). Environmental Systems Div. May 1989. 122p. Available from NTIS, PC A06/MF A01.

This report discusses recent work addressing lime enhancement by slurrying with siliceous materials and testing in a laboratory packed-bed reactor, as part of EPA's efforts to develop low-cost, retrofit flue-gas-cleaning technology, including the development of highly reactive sorbents. The solids generated from a furnace limestone-injection process were reactivated by slurrying at elevated temperatures. Compared with untreated solids, reactivity toward SO_2 was significantly enhanced by hydration. The SO_2 capture by solids increased with increasing time and temperature of hydration. The dry sorbents produced by slurrying several diatomaceous earths, or montmorillonitic clays, with lime were found to be highly reactive with SO_2. The most reactive sorbent was generated by slurrying silica/lime at a weight ratio of 1 to 1. The morphology of the developed sorbents was characterized. Several additives were tested to evaluate their potential to promote the lime/silica reaction rate and increase sorbent reactivity.

51679 (PB–89-214134/XAB) **Evaluation of FGD (flue gas desulfurization) dry-injection sorbents and additives. Volume 2. Pilot plant evaluation of high-reactivity sorbents. Final report, January 1986-December 1987.** Chang, J.C.S.; Jorgensen, C. Acurex Corp., Research Triangle Park, NC (USA). Environmental Systems Div. May 1989. 92p. Available from NTIS, PC A05/MF A01.

See also PB–89-208920.

The report describes a mini-pilot test program to investigate potential new sorbents and processes for dry SO_2 removal. Initial tests showed that the 85 cu m/h pilot plant could be used successfully to evaluate both spray dryer and dry injection processes using traditional calcium- or sodium-based sorbents. The major part of the test program investigated the use of fly ash or diatomaceous earth for enhancement of lime with respect to SO_2 removal in a dry injection process. This part of the test program verified the silica enhancement of $Ca(OH)_2$ which previously had been extensively studied on a bench-scale reactor. The pilot program showed that 50-90% SO_2 removal can be achieved for a stoichiometric ratio of 1 to 2 by dry injection of the silica enhanced lime when using a duct + baghouse configuration, or when using a duct + cyclone configuration including recycle. The sorbent preparation procedure was developed throughout the test program, and an important result was that the silica enhanced lime can be prepared as a semidry sorbent containing 20-30% moisture, suitable for duct injection. Evaporative cooling of the flue gas is allowed as a result of the sorbent injection, thereby lowering the approach to saturation and increasing the SO_2 removal.

51680 Microwave plasma dissociation of hydrogen sulfide. Harkness, J.B.L.; Gorski, A.J.; Daniels, E.J. 12p. American Institute of Chemical Engineers, New York, NY (1988). (CONF-880348–: American Institute of Chemical Engineers spring national meeting, New Orleans, LA (USA), 6-10 Mar 1988).

Technical Paper 72C.

The Claus technology and its associated tail gas cleanup (SCOT unit) for hydrogen sulfide environmental control recovers the sulfur contained in hydrogen sulfide wastes but loses the hydrogen as water. The alternative treatment process proposed in its paper uses plasma dissociation to recover the hydrogen in addition to the sulfur, thereby saving a significant fraction of the lost energy. The plasma process also appears to be more economical than the Claus/SCOT process.

0109 Environmental Aspects

Refer also to citation(s) 51673, 51674, 51702, 52154, 53190, 53191, 53192

0110 Reserves and Exploration

51681 (DOE/EIA–0529) **Estimation of US coal reserves by coal type: Heat and sulfur content.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 11 Oct 1989. 57p. Sponsored by U.S. DOE Management & Administration. Order Number DE90001587. Available from NTIS, PC A04/MF A01 - GPO - OSTI; GPO Dep.

As part of the EIA program to provide information on coal, this report presented detailed estimates as well as descriptions of the data, methods, and assumptions used to develop such estimate of US coal reserves, which are basic to the analysis and forecasting of future coal supply. The estimates presented should be useful in analyzing the many issues related to the coal industry and coal consumers, especially in evaluating various proposed changes to the Clean Air Act. While these estimates are the results of EIA's best effort thus far to compile data on US coal reserves on a uniform, nationwide basis, the data, methodology, and assumptions used to develop such estimates must be updated continuously as new information becomes available. 23 refs., 2 figs., 8 tabs.

51682 (NEDOJ–8809, pp. 459-463) **Outline of coal resources development.** Ishibashi, Daigoro (New Energy Development and Industrial Technology Organization, Tokyo (Japan)). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the 8th NEDO General Assembly*. Available from NTIS (US Sales Only), PC A23/MF A01.

Taking it as a role of NEDO, NEDO has been undertaking various operations to establish appropriate plans and promote the exploration and development of coal in foreign countries, with a long term view for demand and supply and a thoughtful consideration for international cooperation with coal producing countries. In 1987, cooperative coal prospecting in Shantung Province of China and at Sumatra Coal Field located in the middle of Indonesia were carried out. Offland drillings were made in Ariakekai area and offshore of Kushiro. Survey for coal resources in China, coal producing countries in Asean, and Central and South America, as well as investigation for other coal information were performed. Training for foreign languages and business practices, and overseas trainings in North Ameria and Australia were conducted. Representatives were despatched to join in the international conference of IEA agreement to exhcange information. An IEA conference was held in Japan in October. In 1987, the current status and outlook of the coal flow as well as requirements and method of cooperation concerning coal development and utilization were investigated laying stress on Southeast Asia. The outline of the business plan for 1988 is described. 1 figure, 1 table.

51683 (NEDOJ–8809, pp. 464-496) **Prospecting in Ensham project.** Hayashi, Jiro (Idemitsu Kosan Co., Ltd., Tokyo (Japan)). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the 8th NEDO General Assembly*. Available from NTIS (US Sales Only), PC A23/MF A01.

Having performed the 3 stages of general exploration, minute prospecting and detailed investigation of geology, coal distribution, coal properties, etc. in the opencut area after the approval of ATP 426, trial 10,000 ton coal mining and cumbusition test using actual machines, the coal prospecting in Enshal Project is now in the present status. As regard to ATP 426 prospecting, the outlines of the organization, result of exploration, field operation, indoor works, drilling work, and daily life in the field are introduced. Description is made for geological formation, geological structure, coal properties, and reserve. In the opencut area, efficient prospecting was carried out, and detailed geological information was offered for making mine plans and invetigation for commercialization. In the ATP 426C, there exists the total coal resources of 1.5 billion tons in the Rangal coal bearing formation alone, beneath of which coal deposit of German creek coal measures was confirmed to exist. Acquisition of the

coal resources in ATP 426C will surely contribute towards the stable coal supply. 17 figures, 13 tables.

51684 (NEDOJ–8809, pp. 497-519) **Basic research for the development of coal resources.** Yagi, Shozo. New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the 8th NEDO General Assembly.* Available from NTIS (US Sales Only), PC A23/MF A01.

Based on the result of the previous investigation, offshore physical prospecting was carried out in 1987 in the Nishihiki area. The objective of the investigation is the development and improvement of exploration and analysis technologies for coal resources through the study of geological structure, possibility of existence of coal formation, and the application of 3 dimensional prospecting method which was tried for the first time in Japan for coal exploration. The features of the reflected wave became clear by comparing drilling result with the section of reflection. The analyzed results of specific gravity, magnetic intensity, refracted wave, and three dimentional exploration method are reported. As the result of the investigation, reports are made on the geological structure, study of the surface structure of main coal formation in the area where three dimensional prospecting was carried out, and the possibility of the existence of coal resources. The three dimensional exploration method applied for the first time proved to be an effective exploration method, enabling the investigation of semi-dome structure and minute structre of small fault with less than 10 m fall. 13 figures, 1 table.

0120 Mining

Refer also to citation(s) 51655

51685 (DOE/PC/88949–T3) **Advanced research in solids transport: Rheological behavior of dense suspensions: Third quarterly report, April 1, 1989–June 30, 1989.** Westinghouse Electric Corp., Pittsburgh, PA (USA). Science and Technology Center. [1989]. 34p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88949. Order Number DE90001085. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objective of this program is to develop a basic understanding of the fundamental rheological properties of high solids concentration (50% to 100%) slurries and wet cake. During this quarter the goals of Task 3 were advanced. The dynamic shear cell was completed and shakedown experiments begun. In order to have a basis for comparison with published technology experiments were performed with the Jenike shear cell and glass beads. Experiments were also performed with dry glass beads in the dynamic shear test cell. 5 refs., 7 figs., 12 tabs.

51686 (PB–89-201347/XAB) **Rotary-drilling techniques used in the Beckley Coalbed. Report of Investigations/1989.** Goodman, T.W. Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. 1989. 18p. (BUMINES-RI–9238). Available from NTIS, PC A03/MF A01.

Library of Congress catalog card No. 88-600412.

The U.S. Bureau of Mines used a contract drilling strategy with short-collared assemblies in order to rotary-drill long horizontal methane drainage holes in the Beckley Coalbed near Glen Daniel, WV. By decreasing the thrust and increasing the rotation of the drill bit when in contact with the roof and floor rock, assemblies with 1-ft (0.3-m), 10-ft (3-m), and 14-ft (4.3m) long collars were made to deflect and stay in the coalbed. Successful application of the procedure resulted in holes drilled full length in coal with the original assembly including bit. The test assemblies deflected away from the original bearings of the holes during drilling and arced. Four holes were drilled to depths ranging from 478 ft (145.7 m) before the strategy was developed, to 4,034 ft (1,230 m) when the strategy was applied. Total length of the holes in coal was 8,590 ft (2,618 m). After 577 days the total methane captured by the holes was 221,600,000 cu ft (6,276,000 cu m). The methane flow rate peaked at 805,000 cu ft/d(18,974 cu m/d) after 6 months.

51687 (PB–89-201354/XAB) **Evaluation of high-pressure front-mounted water jets for frictional-ignition suppression. Report of Investigations/1989.** Taylor, C.D.; Furno, A.L. Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. 1989. 15p. (BUMINES-RI–9237). Available from NTIS, PC A03/MF A01.

Library of Congress catalog card No. 88-600410.

The U.S. Bureau of Mines conducted a laboratory study to determine what effect use of water-jet-assisted cutting has on frictional-ignition suppression. A single bit with a steel tip, installed on a rotating drum, repeatedly made 22-in-long cuts in a block of Berea sandstone. The drum was operated in an enclosure that contained an explosive methane-air mixture. High-pressure front-mounted water jets operating at 2,000 to 5,000 psig and low-pressure rear-mounted sprays operating at 80 psig were used; the numbers of ignitions that occurred with each type of spray were compared. The rear-mounted spray was more effective for preventing frictional ignitions than the front-mounted water jet.

51688 (PB–89-201388/XAB) **Capillary wetting response of coal after exposure to ambient air atmosphere. Report of Investigations/1989.** Kilau, H.W.; Pahlman, J.E. Bureau of Mines, Twin Cities, MN (USA). Twin Cities Research Center. 1989. 34p. (BUMINES-RI–9234). Available from NTIS, PC A03/MF A01.

Library of Congress catalog card No. 88-600323.

The U.S. Bureau of Mines examined the wettability of bituminous and subbituminous coals before and after exposure to ambient air atmosphere, as part of an ongoing project investigating the coal-wetting abilities of surfactant solutions intended for the suppression of dust during coal-mining operations. Exposure periods were generally 7 days or less, and the changes in wetting response were measured with a capillary penetration apparatus. Wetting solutions tested included a nonionic surfactant, two anionic surfactants, and pure distilled water. After exposure, higher-ranked bituminous coals treated with nonionic surfactant solution and pure water showed increased wettability, but lower-ranked subbituminous coals showed decreased wettability. With the anionic surfactants, the coals demonstrated opposite responses. The wettability changes appeared to be related to the coal moisture content. These changes may be amplified by specific, but incompletely understood, interactions between surfactant, polar groups, absorbed water, and the coal surface.

51689 (PB–89-201396/XAB) **Respirable dust generation: Comparison of continuous and conventional mining methods when excavating rock in coal mines. Report of Investigations/1989.** Organiscak, J.A. Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center. 1989. 16p. (BUMINES-RI–9233). Available from NTIS, PC A03/MF A01.

Library of Congress catalog card No. 88-600436.

The U.S. Bureau of Mines recently conducted an investigation into the amount of respirable and quartz dust generated while mining rock in coal mines by continuous and conventional methods. The study was made at two mines that use both continuous and conventional mining. Results show that continuous mining produces 1.2 to 3 times more respirable dust, and 6.7 to nearly 15 times more quartz dust than conventional mining.

51690 (PB–89-201420/XAB) **Comparative study of blasting vibrations from Indiana surface coal mines. Report of Investigations/1989.** Siskind, D.E.; Crum, S.V.; Otterness, R.E.; Kopp, J.W. Bureau of Mines, Twin Cities, MN (USA). Twin Cities Mining Research Center. 1989. 48p. (BUMINES-RI–9226). Available from NTIS, PC A03/MF A01.

Library of Congress catalog card No. 88-600303.

The U.S. Bureau of Mines performed a comparative study of nine sites at eight surface coal mines to determine if the presence of near-surface underground abandoned workings resulted in the generation of adverse long-duration, low-frequency blast vibrations. Six of the nine sites had underlying workings, and two had thick layers of low-velocity unconsolidated surface material. Extended seismic arrays were used to identify the vibration characteristics within a few tens of feet of the blasts and also as modified by the propagating media at distances over 1 mile. Production blasts and specially fired single-charge blasts allowed the determination of natural ground frequency and the influence of initiation delay timing. Vibration amplitudes from the production blasts at all sites exceeded historical norms, particularly at the greater distances.

51691 (PB–89-201479/XAB) **Reducing miner absenteeism. Information Circular/1989.** Peters, R.H.; Clingan, M.R.; Randolph, R.F. Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research

Center. May 1988. 34p. (BUMINES-IC–9219). Available from NTIS, PC A03/MF A01.

Library of Congress catalog card No. 88-600339.

The U.S. Bureau of Mines has prepared the report on strategies for maintaining high job attendance among underground coal miners because high absenteeism is a threat to miners' safety and seriously hampers productivity. A substantial number of research studies on the effectiveness of various strategies for reducing absenteeism among the employees of nonmining industries have been reported in the literature. These strategies have aimed at improving job attendance through one or more of the following: improving employment procedures, overcoming problems that adversely affect one's ability to attend work, and increasing miners' motivation to attend work. Many of these strategies appear applicable to the mining industry and are reviewed in the first half of the report. The second half of the report describes how one could develop and implement a program for maintaining high attendance at underground coal mines.

51692 (PB–89-205157/XAB) **Control of diesel exhaust emissions in underground coal mines: Fuel modifications. Open file report, September 1978-December 1988 (Final).** Callahan, T.J.; Ryan, T.W.; Dietzmann, H.E.; O'Neal, G.B. Southwest Research Inst., San Antonio, TX (USA). Dec 1988. 156p. (SWRI–5483). Available from NTIS, PC A08/MF A01.

See also PB–88-133673.

The use of various alternative and modified fuels in diesel engines was investigated as a method for controlling particulate and oxides of nitrogen emissions. The effect of these fuels on the carbon monoxide and hydrocarbon emissions was also documented. The test fuels were screened using a Caterpillar 3304 diesel engine converted to single-cylinder operation. Selected fuels were subsequently evaluated using full-scale engine tests. Engine modifications were made to optimize the performance of the alternative fuel. Transient and steady-state emissions data are reported for the optimized and baseline engine. The effects of the transient operation of the engine on the exhaust emissions was investigated. A method was developed for predicting transient-cycle exhaust emission based upon the cycle speed and torque profile and steady-state emissions data.

0130 Transport and Handling

Refer also to citation(s) 52414

51693 (DOE/PC/88951–2) **Determination of flow-regime boundaries for cohesive particles: Quarterly report, December 20, 1988–March 19, 1989.** Knowlton, T.M. Institute of Gas Technology, Chicago, IL (USA). Oct 1989. 40p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88951. Order Number DE90001405. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The purpose of this work is to develop a hydrodynamic model capable of predicting the choking/non-choking flow regime boundary for cohesive solids. There are six tasks in this study: (1) preparation of a project work plan, (2) hydrodynamic model development, (3) determination of solid rheological properties for incorporation into the hydrodynamic model, (4) small-scale flow tests, (5) large-scale flow tests, and (6) comparison of model with data and preparation final report. This quarter the hydrodynamic model was tested (Task 2) against the literature results of Bader, Findlay, and Knowlton (1988). In Task 3, the commercial Hosokawa cohetester was received. Initial testing was conducted to determine the interparticle forces (cohesive forces) of oil shale with an average particle size of 5 microns. 35 refs., 14 figs., 4 tabs.

51694 (DOE/PC/90958–T9) **Studies of dense phase cohesive coal transport in plugs: Quarterly report, July–September 1989.** Klinzing, G.E.; Aziz, Z.B. Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering. 1989. 21p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-86PC90958. Order Number DE90000720. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

It was found that the plug flow delivering unit can be operated more efficiently by transporting the solids in suitable shot plug lengths and consolidating the plug before transfer. This type of operations uses a minimum amount of transport gas, reduces the risks of plugging the transfer line, and minimizes the pressure losses. It is the attention of this paper to indicate some of the optimal procedures to operate a plug flow unit delivering pulverized coal suitable for normal boilers feed in 2 inch (5.08 cm) PVC pipe. 4 refs., 7 figs., 4 tabs.

0140 Combustion

Refer also to citation(s) 51620, 51623, 52145, 52155

51695 (CRIE-T–87068) **Electrostatic agglomeration apparatus with multipole electrodes (Part 1). Presentation of the apparatus and its preliminary experiment.** Watanabe, Tsuneo. Central Research Inst. of Electric Power Industry, Komae, Tokyo (Japan). Energy and Environment Lab. Sep 1988. 30p. (In Japanese). Order Number DE89782320. Available from NTIS (US Sales Only), PC A03/MF A01.

It is considered to apply the high-performance of an electrostatic precipitator using an agglomeration apparatus, which is installed in the intermediate stage of the precipitator, for collecting submicron aerosol particles exhausted from a fine grained coal burning boiler. This report describes a possibility of magnification of the submicron particles through the electrostatic agglomeration, and explains the new electrostatic agglomeration apparatus with multipole electrodes. And the report also describes the newly developed Aerosol Particle Motion Analyzing Apparatus (APMAA), which contains the aforementioned electrostatic agglomeration apparatus. The APMAA is composed of a flow rectifier, a charging aerosol production apparatus, an electrostatic agglomeration apparatus, an electrostatic precipitator unit. A charging is from a power source for alternative voltage superposed on a DC voltage. The preliminary experiment result of fly ash particles shows an effective agglomeration function in the region of submicron. 16 refs., 21 figs., 5 tabs.

51696 (DOE/FE–0144) **An analysis of markets for small-scale, advanced coal-combustion technology in Spain, Italy, and Turkey.** USDOE Assistant Secretary for Fossil Energy, Washington, DC (USA). Office of Planning and Environment. Sep 1989. 98p. Sponsored by U.S. DOE Fossil Energy. Order Number DE90000997. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This report describes the results of an in-depth analysis of markets for US-developed, advanced coal-combustion technology (ACT) in the residential, commercial, and industrial sectors of three countries – Spain, Italy, and Turkey. These countries were chosen in a previous study, in which member countries of the Organization for Economic Cooperation and Development (OECD) were rated on eight factors influencing their propensity to use small-scale, US-developed ACT. 76 refs., 16 figs., 14 tabs.

51697 (DOE/PC/79916–6) **Determination of local radiative properties in coal-fired flames: Progress report, March 15, 1989–June 15, 1989.** Menguec, M.P. Kentucky Univ., Lexington, KY (USA). Dept. of Mechanical Engineering. [1989]. 16p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-87PC79916. Order Number DE90000027. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

During this period of the research, we have made progress in several areas, including the theoretical inverse analyses, experimental cold-coal-flow system, coal-burner, and optical arrangements, and have completed one fundamental aspect of the study. The discussion in this report is divided into two main components to cover (A) Basic and theoretical studies, and (B) Experimental studies. In part (A), we will discuss our recent efforts for the inverse solution of radiative transfer equation. In part (B), we discuss our recent efforts in developing optical platform/rail and detector assemblies for the experiments.

51698 (DOE/PC/88929–T2) **Scale-up of circulating fluidized bed coal combustors: Progress report, Fourth quarter, June 1, 1989–August 31, 1989.** Louge, M.Y. Cornell Univ., Ithaca, NY (USA). Sibley School of Mechanical and Aerospace Engineering. [1989]. 18p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-88PC88929. Order Number DE90001459. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This project is aimed at quantifying the effects of scale-up upon the hydrodynamics of circulating fluidized bed coal combustors (CFB). To this end, we have constructed at Cornell a cold CFB facility that can operate with controlled fluidization gas mixtures. In addition, we have developed new capacitance diagnostics to measure local voidage in the bed. In order to test the new facility and its diagnostics, we have fluidized a fluid cracking catalyst (FCC) with air, and we have studied in detail the voidage behavior near the wall of the CFB riser. In addition, we have developed a model for heat transfer in the pneumatic transport of large particles. This model sheds some light on the mechanisms of heat transfer in regions where the collisional interaction among particles plays an important role. The present report will primarily describe this model and discuss its predictions. 13 refs., 3 figs.

51699 (SVF–290) **NO_x discharge from spreader stoker boilers: literature study.** Hjalmarsson, A.-K. Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden). Dec 1987. 51p. Available from Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden).

This study shows that articles dealing with NO_x emissions come mainly from the USA, where many spreader stokers are in operation. In the early 1980s an extensive program was carried out in order to make this type of boiler competitive when considering both the economic and the environmental aspects. Research has been carried out in bench -and model scale and measurements have been made on full-scale boilers. The purpose of most of the studies has been to map and optimize the removal of emissions in general, and not just the NO_x emissions. This has been achieved by reducing the total amount of excess air, adjusting the ratio of primary to secondary air, removing fines from the fuel and incorporating flue gas recycling. In general, it has been found that changes in operation and equipment modification to reduce emissions has also improved boiler efficiency and vice versa. In Europe, very little has been published regarding spreader stoker boilers and NO_x emissions possibly because at present for most boilers there are no regulations governing these emissions. In Sweden there are 3 spreader stoker boilers in Boraas, Goeteborg and Linkoeping. Emission values of 0.22-0.26 g NO_2/MJ when burning coal have been recorded with 0.15 g NO_2/MJ emitted when burning wood chips and combinations of wood chips and coal. No attempts have been made to reduce NO_x emissions further.

51700 **A comparison of the combustibility of chars in fixed-bed and fluidised-bed reactors.** Khan, M.R. (USDOE Morgantown Energy Technology Center, WV); Lee, Y.Y. *Journal of the Institute of Energy (UK),* 62(451): 79-82 (Jun 1989).

Earlier studies had demonstrated that chars from coal pyrolysed at relatively low temperatures are more reactive than those prepared at high temperatures. These reactivity results were measured in a thermogravimetric analysis (TGA) system. The reactivities of the same chars have now been measured in a fluid-bed reactor at 475 degrees and 800 degrees C in air. The relative reactivity of the chars of 1 mm mean diameter were studied by the injection of small batches of the particles into a 7.3 cm diameter electrically heated fluidised bed. To determine the weight-loss during combustion, the partly burned particles were retrieved by means of a movable gauze basket and quenched in a stream of nitrogen. The particle temperature was estimated by means of a single-particle burning model developed for other studies. The relative reactivity of chars was observed to fall with rising char-preparation temperature; this finding is consistent with the TGA reactivity results. The greater reactivity of the mild-gasification chars is attributed to their higher concentration of active surface area. 20 refs., 8 figs., 4 tabs.

51701 **Population-balance model of physical transformations of ash during char oxidation.** Kerstein, A.R. (Sandia National Labs., Livermore, CA (USA). Combustion Research Facility). *Combustion and Flame (USA),* 77(2): 187-200 (Aug 1989).

A population-balance model, involving a set of coupled rate equations, is formulated to represent the agglomeration of fused ash droplets on the surface of an oxidizing char particle. Numerical solutions reproduce several features and trends obtained previously by Monte Carlo simulation. The present formulation identifies the key aspect of this phenomenology, namely the competition between the relaxation to a steady-state surface-droplet distribution and the departure from this steady state due to the increasing curvature of the particle perimeter. A principal consequence of this competition is that the mean surface-droplet diameter is predicted to exhibit an inflection point when plotted as a function of particle radius or fractional conversion.

51702 **Reaction of nitric oxide with bound carbon at flame temperatures.** Cheng, M.T. (Louisiana State Univ., Baton Rouge, LA (USA). Dept. of Mechanical Engineering); Kirsch, M.J.; Lester, T.W. *Combustion and Flame (USA),* 77(2): 213-217 (Aug 1989).

This paper describes an experimental study conducted to evaluate the global rates of the reaction of NO with carbon black particulates at flame temperatures. The results indicate that the NO removal rates on carbon blacks are much greater than rates determined previously for NO removal on Char. The role soot particles play in NO destruction mechanisms in a pulverized coal flame may be significant.

0150 Marketing and Economics

Refer also to citation(s) 51696, 52419

51703 (CONF-890916–2) **US clean coal technologies: International markets and competitive issues.** Szpunar, C.B.; Gillette, J.L. Argonne National Lab., IL (USA). 28 Sep 1989. 22p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-31109-ENG-38. From 6. annual international Pittsburgh coal conference; Pittsburgh, PA (USA); 25-29 Sep 1989. Order Number DE90001989. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

One objective of this study is to impact the US clean coal technology (CCT) demonstration program regarding its direction and the content of its continuing research and development, with respect to international markets. The study areas addressed to date include: the characterization of specific demand centers, representative of expanding international markets in industrialized and developing countries, the identification of RD&D initiatives of countries competing with the US, the identification of barriers to international competitiveness, and the characterization of US and competitive technologies believed to have significant potential in the international market. This paper highlights our study progress to data with respect to areas 1–3. Area 4, an item of considerable interest and the subject of ongoing work, will not be addressed herein. 48 refs.

51704 (DOE/FE–0143) **Guide to federal export assistance activities applicable to the US coal and coal technologies industry.** USDOE Assistant Secretary for Fossil Energy, Washington, DC (USA). Office of Planning and Environment. Sep 1989. 282p. Sponsored by U.S. DOE Fossil Energy. Order Number DE90000949. Available from NTIS, PC A13/MF A01 - OSTI; GPO Dep.

The federal government provides a complete range of programs and services that can assist United States (US) coal and coal-technology firms as they expand into the foreign marketplace. These programs cover the spectrum of business export needs, which include: providing assistance in identifying target markets, locating specific business opportunities and foreign joint-venture partners, arranging business appointments, organizing trade missions, sponsoring feasibility studies, conducting trade analyses, providing financing, insuring investments, and providing in-country training and assistance. Under the sponsorship of the Department of Energy's (DOE) Office of Fossil Energy (FE), this Guide has been developed to address this problem. It is intended to provide coal and coal technology firms with a single reference source for identifying US government agencies, programs, and contacts that might aid in exporting. The Guide contains an in-depth discussion of the eight major agencies offering export assistance: the Agency for International Development (AID), the Departments of Commerce (DOC) and State (DOS), the Export-Import Bank (Eximbank), the Overseas Private Investment Corporation (OPIC), the Small Business Administration (SBA), the Trade and Development Program (TDP), and the Office of the US Trade Representative (USTR). In addition, this guide identifies pertinent activities performed by other federal agencies that might assist coal and coal-technologies exporters, including the Departments of Defense (DOD), Education, Energy (DOE), and Labor (DOL).

51705 (ECE/GE–89-32232/3185e) **The coal situation in the ECE [Economic Commission for Europe] region in 1988 and global prospects for coal.** United Nations, Geneva (Switzerland). Economic Commission for Europe. 23 Aug 1989. 113p. Order Number DE90002113. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI.

A report is presented from the Economic Commission for Europe (Coal Committee) on global prospects for coal. Included is a discussion on macro-economic factors, general energy features, energy policy, the general outlook for coal, coal and coke production, consumption by user sections and regions, international trade in hard coal, and prices. 14 figs., 7 tabs. (CBS)

51706 (NEDOJ–8809, pp. 520-539) **Promotive study on preparation of basis for foreign coal import. Study on coal renaissance.** Muraoka, Yoji (Japan Economic Research Institute, Tokyo). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the 8th NEDO General Assembly.* Available from NTIS (US Sales Only), PC A23/MF A01.

This is an interim report on the coal renaissance study carried out in 1987 as a part of the Promotive Study on Preparation of Basis for Foreign Coal Import. The background and ideology of coal renaissance, future aspect of demand for coal, problems pertaining to the expansion of application, and a proposal for the expansion of coal usage are described in order. The role of coal expected as an alternate fuel for petroleum, development of new application fields for coal, conversion to coal, contribution of Japan to the stablization of international coal supply are outlined. Coal renaissance aims, based on technology, at stimulation of coal demand, change in the image of coal, and the utilization of the accumulated abundant knowhow. The aspect of coal demand in 2000, solution and current status of various restricting factors relating to the use of coal in general industry, and the remaining problems are discussed. 6 figures, 10 tables.

51707 (PB–89-206858/XAB) **Survey of government assistance for the world's hard-coal industries.** Neme, L.A.; Yancik, J.J. International Trade Administration, Washington, DC (USA). Office of Energy. May 1989. 195p. Available from NTIS, PC A09/MF A01.

Also available from Supt. of Docs.

This report investigates the existence and use of subsidies and incentives that foreign nations give their coal industries. Of particular interest are those aids that promote and facilitate the export of coal. A survey of hard coal producing countries was conducted to compile, and quantify if possible, direct and indirect financial aids given by governments for the purposes of maintaining, expanding or creating an indigenous coal industry and facilitating exports. The survey found that government measures commonly used to maintain, expand or create coal production include deficit operating grants, capital grants, preferential loan credits, labor and tax benefits, and export marketing assistance. Typical measures used to guarantee and protect domestic coal markets are long-term supply agreements, price supports, government purchases, tariffs, import licenses, and quotas. Common types of financial assistance provided by governments that do not benefit current coal production or use are research and development funds, environmental grants for restoring past mined lands, and payments to unemployed miners.

0160 Health and Safety

Refer also to citation(s) 51686, 51687

02 PETROLEUM

51708 **Environmental protection: New opportunities for petroleum geoscientist.** Muhr, C. (Oak Ridge National Lab., Grand Junction, CO (USA)). *AAPG Bulletin (American Association of Petroleum Geologists) (USA),* 73(9): 1168 (Sep 1989). (CONF-8910195–: AAPG Rocky Mountain Section meeting, Albuquerque, NM (USA), 1-4 Oct 1989).

The hazardous waste industry offers opportunities for the petroleum geoscientist to use present skills in new ways. Indeed, the petroleum geoscientist possesses skills which are currently in great demand in the hazardous waste industry. By 1990, over $20 billion/year will be spent in the US to comply with Superfund and other waste-related regulations. The environmental characterization and remediation field therefore represents enormous professional opportunities for those geoscientists who have been hit hard by the continuing economic slump in the oil industry. An understanding of contaminant characteristics such as chemical makeup, modes of transportation, methods of detection, volume determinations, well testing methods, and remediation and recovery techniques is essential in the hazardous waste industry. Not surprisingly, many of these skills may seem familiar for they often have similarities to, or their origins in, petroleum exploration. These similarities allow the petroleum geologist, engineer, etc., to step in, understand, and improve the present technologies used in hazardous waste characterization and cleanup. Examples of innovations in the hazardous waste industry by utilizing petroleum industry technologies are the adaptation of Horners' method of air permeability measurements in the unsaturated zone and single well-testing techniques. Whether in disposal facility design, contaminant characterization, or remedial design, demand will continue to be great for those people able to apply petroleum exploration techniques to the hazardous waste industry.

0202 Geology and Exploration

51709 (DOE/BC/10849–15) **Systematic procedure for reservoir characterization: Final report.** Lake, L.W.; Kocurek, G.A.; Miller, M.A. Texas Univ., Austin, TX (USA). Oct 1989. 233p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-85BC10849. Order Number DE89000765. Available from NTIS, PC A11/MF A01 - OSTI; GPO Dep.

Reservoir characterization, as applied to numerical reservoir simulation, is a hybrid discipline involving mathematics, geology and engineering. Each area having evolved as a distinct area of study, the translation of information among the groups is sometimes difficult and slow. We describe in this Final Report the culmination of three-year project with the overall objective of encouraging such transfer of information. We discuss the results of geologic, numerical and geostatistical studies dealing with and/or derived from the Page sandstone in northern Arizona. The Page sandstone is an eolian analog to oil-producing reservoirs in the US Rocky Mountains and the North Sea. The Page data analysis concludes with this report, and we also include insights about the portability of observations from subsurface to outcrop data and from Page to other eolian formations. Based on a few general trends, we have developed, and report below, a geostatistical permeability generation scheme which is, to our knowledge, the first such method derived exclusively from geology. Finally, the work concludes with a series of numerical simulations through a portion of the Page outcrop. These simulations lead to more fundamental work dealing with viscously unstable displacements in randomly heterogeneous media. 76 figs., 8 tabs.

51710 (DOE/BC/14425–1) **Establishment of an oil and gas database for increased recovery and characterization of oil and gas carbonate reservoir heterogeneity: [Quarterly technical progress report], July 1–September 30, 1989.** Mancini, E.A. Alabama Geological Survey, University, AL (USA). 19 Apr 1989. 10p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-89BC14425. Order Number DE90001230. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The objective of this project is to augment the National Reservoir Database (TORIS database) and to increase our understanding of geologic heterogeneities that affect the recoveries of oil and gas from carbonate reservoirs in the State of Alabama and to identify those resources that are producible at moderate cost. This objective will be achieved through detailed geological, geostatistical, and engineering characterization of typical Jurassic Smackover Formation hydrocarbon reservoirs in selected productive fields in the State of Alabama. These studies will be utilized to develop and test mathematical models for prediction of the effects of reservoir heterogeneities.

51711 **Improving the performance of parallel (and serial) reservoir simulators.** Barua, J. (Stanford Univ. (US)); Horne, R.N. pp. 524 of Proceedings of the tenth SPE symposium on reservoir

simulation. Society of Petroleum Engineers, Richardson, TX (1989). (CONF-890234–: 10. Society of Petroleum Engineers symposium on reservoir simulation, Houston, TX (USA), 6-8 Feb 1989).

Technical Paper SPE 18408.

Parallel computers hold much promise for scientific computation. So a great deal of effort has been devoted to finding ways to parallelize linear equation solvers. However, in fully implicit reservoir simulators the real problem is the solution of non-linear equations. This paper shows how a judicious combination of linear and non-linear solution techniques can lead to the fastest overall simulator., It uses a combination of an approximate iterative solution of the Jacobian and a Quasi-Newton method. The proposed method makes it possible to use the highly parallelizable Jacobi matrix solution techniques, which are poorly convergent, and still get good serial performance. Experiments on a parallel computer show that even with a highly parallel method, problem sizes need to be quite large to get good efficiency. The proposed method can also be used to speed up serial programs by simply using a good serial technique to iteratively solve the linear equations.

51712 **An analytical method to calculate the effective permeability tensor of a grid block and its application in an outcrop study.** Kasap, E. (Univ. of Texas, TX (US)); Lake, L.W. pp. 524 of Proceedings of the tenth SPE symposium on reservoir simulation. Society of Petroleum Engineers, Richardson, TX (1989). (CONF-890234–: 10. Society of Petroleum Engineers symposium on reservoir simulation, Houston, TX (USA), 6-8 Feb 1989).

Technical Paper SPE 18434.

How to calculate an effective permeability tensor for a grid block in a numerical simulation of a heterogeneous reservoir remains a difficult problem of reservoir characterization. Although several numerical and statistical procedures have appeared in the literature, none can be inserted easily into a simulation, being either developed for a very specific problem or requiring some prior simulation runs. In this study the authors propose an analytic method to calculate effective block permeabilities as a full tensor based on geometry, block size, tensorial local permeabilities and the geology within the block. The method is based on flow through parallel and serial cross-beds which is subsequently rotated to arrive at tensorial permeabilities from the orientations of these beds. The method has been validated using a finite element numerical simulator which models the permeability discontinuities explicitly. The proposed analytical method can be inserted into numerical simulators to calculate effective tensorial permeabilities of heterogeneous permeable medium. The authors apply the procedure to a simulation of flow through an outcrop of eolian Page Sandstone.

51713 **Mechanism for formation of regional fractures at depth in flat-lying reservoirs.** Lorenz, J.C. (Sandia National Labs., Albuquerque, NM (USA)); Teufel, L.W.; Warpinski, N.R. *AAPG Bulletin (American Association of Petroleum Geologists) (USA)*, 73(9): 1165 (Sep 1989). (CONF-8910195–: AAPG Rocky Mountain Section meeting, Albuquerque, NM (USA), 1-4 Oct 1989).

Regional or systematic fractures form slowly at depth, in extension, and parallel to regional horizontal tectonic compression. Such fracture sets are important contributors to reservoir permeability and can be common despite the absence of flexure in strata. High formation pore pressures are crucial to creating effectively unconfined conditions and how effective stresses. But pore pressure does not cause fracturing; measurements of in-situ stresses have never documented a least principal stress that is less than the pore pressure, and theoretically such conditions would be rare. Many proposed fracture mechanisms, especially natural hydraulic fracturing, are incompatible with the characteristics of regional fracture sets. Rather, such fractures initiate at flaws in the rock at a critical differential stress and propagate quasistatistically, normal to the least compressive stress. The differential stress required for initiation and propagation is well below that necessary for shear failure, and failure in extension occurs under conditions of relatively low effective confining stress. This mechanism is supported by numerous published laboratory data. Quasistatic propagation is commonly arrested by stress contrasts encountered at lithologic discontinuities, producing irregular fracture distributions if reservoirs are sedimentologically heterogeneous. In the presence of high pore pressures, fractures can be held open at depth by tectonic stress, and mineralization is commonly precipitated in the open void space.

0203 Drilling and Production

Refer also to citation(s) 51710, 52415, 53569

51714 (DOE/BC/14126–11) **Pressure transient analysis for composite systems.** Ambastha, A.K. Stanford Univ., CA (USA). Petroleum Research Inst. Oct 1989. 164p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-87BC14126. (SUPRI-TR–68). Order Number DE89000768. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

A composite reservoir model is used to analyze well-tests from a variety of enhanced oil recovery project, geothermal reservoirs, and acidization projects. A composite reservoir is made up of two or more regions. Each region has its own rock and fluid properties. Transient pressure behavior of a well in a two-region composite reservoir has been considered extensively in the literature, and several methods have been proposed to estimate front (or discontinuity) radius, or swept volume. The study considers transient pressure derivative behavior of a well in a two-region composite reservoir to establish the applicability and the limitations of different methods to estimate front radius or swept volume. A finite-radius well with wellbore storage and skin is assumed to reduce (or inject) at a constant rate. Three outer boundary conditions are considered: infinite, closed, and constant-pressure. A study of drawdown and buildup responses has resulted in a set of correlating parameters for the pressure derivative responses, and new design and interpretation relations for well-tests in composite reservoirs. Guidelines have been presented for the applicability of different methods to estimate front radius. Dynamic phenomena, such as phase changes and multi-phase flow effects in a region near the front, can cause a sharp pressure drop at the front. Such a sharp pressure drop is modeled as a thin skin at the front in this study. An analytical solution for the transient pressure behavior of a well in a two-region composite reservoir with a skin at the front is obtained using the Laplace transformation. A thin skin at the front can explain a short duration pseudosteady short duration pseudosteady state even for small mobility and storativity contrasts. Pressure derivative behavior of a well in a homogeneous, or a three-region composite reservoir is also discussed. 93 refs., 75 figs., 11 tabs.

51715 (DOE/BC/14126–12) **Devices and methods for in-situ combustion ignition.** Shallcross, D.C. Stanford Univ., CA (USA). Petroleum Research Inst. Oct 1989. 34p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-87BC14126. (SUPRI-TR–69). Order Number DE89000766. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

One of the most important tasks during a fireflood is to ensure the ignition of the oil-bearing stratum efficiently and safely. Many different devices have been developed and employed to achieve this aim. The target zone may ignite spontaneously upon injection of an oxygen-containing gas without the aid of special equipment. Alternatively, ignition may be hastened or enhanced by the use of gas-fired downhole burners, catalytic heaters, electric downhole heaters, or other, chemical means. Other methods involve increasing the reactivity of the formation contents by doping the stratum with compounds that ignite and burn more readily than the reservoir oil. This report surveys the range of ignition methods and devices that have been developed and applied in the field. Not only are successful ignition systems discussed, but also those designs that failed to ignite a formation. In discussing the various techniques, factors considered include reliability, specialized equipment and material requirements, and safety. Another consideration is whether a system or device may be easily reused if ignition is not successful on the first attempt. The use of oxidizing gases than air is also discussed. 108 refs., 3 tabs.

51716 (DOE/BC/14126–13) **Phase change in binary systems in porous media: Application to solution gas drive.** Yortsos, Y.C.; Parlar, M. University of Southern California, Los Angeles, CA (USA). Oct 1989. 53p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-87BC14126. Order Number DE89000767. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

In this paper, a study of the liquid-to-vapor phase change by pressure decline in porous media is presented. A simplified solution gas drive system is taken as a representative example. The issues of nucleation, critical supersaturation, and vapor phase growth in porous media are critically examined. At low supersaturations a percolation approach is proposed that allows for the estimation of critical gas saturation and relative permeabilities from nucleation and pore structure characteristics. 44 refs., 8 figs.

51717 **A new semianalytical method for numerical simulation of fluid and heat flow in fractured reservoirs.** Pruess, K. (Lawrence Berkeley Labs. (US)); Wu, Y.S. pp. 524 of Proceedings of the tenth SPE symposium on reservoir simulation. Society of Petroleum Engineers, Richardson, TX (1989). (CONF-890234–: 10. Society of Petroleum Engineers symposium on reservoir simulation, Houston, TX (USA), 6-8 Feb 1989).

Permeability and flow in many petroleum, gas, and geothermal reservoirs are dominated by fractures. Despite major advances in recent years, mathematical modeling of fluid and heat flow in fractured reservoirs remains a difficult problem. Porous medium approximations have been shown to be inadequate for many flow processes in fractured systems, while double- or multiple-porosity techniques may involve excessive amounts of numerical work or large discretization errors. The authors have developed a new method for modeling fluid and heat flow in fractured reservoirs which is an extension of a technique developed for calculating heat exchange between permeable layers and impermeable semi-infinite confining beds during thermally enhanced oil recovery. The authors' method combines a finite-difference description of global flow in the fractures with an analytical representation of interporosity flow by means of trial functions for fluid pressures and temperatures in the matrix blocks.

0204 Processing

Refer also to citation(s) 51627, 51630, 51633, 51637

0205 Products and By-products

Refer also to citation(s) 52494, 52495

51718 (AD-A–208925/8/XAB) **Lubricant evaluation and performance. Final technical report, January 1987–June 1988.** Saba, C.S.; Smith, H.A.; Keller, M.A.; Kauffman, R.E.; Jain, V.K. Dayton Univ., OH (USA). Research Inst. Apr 1989. 553p. (UDR-TR–88-95). Available from NTIS, PC A24/MF A01.

This effort involved the development of improved methods for defining and measuring turbine engine lubricant performance and the development of improved techniques for lubricant monitoring, lubrication system health monitoring, investigating antiwear characteristics and load carrying capacities of lubricants. In Task I, Arrhenius plots were developed for describing the effective life of MIL L 7808, MIL-L-23699 and 4 cSt viscosity candidate lubricants as a function of time and temperature for selected limiting values of changes in physical and chemical properties. In Task II, significant improvement in AE spectrometer sensitivity for analyzing wear metal particles was achieved when using a cup-tip electrode with the reversible polarity pin stand. In Task III, the COBRA, a dielectric constant (DC) tester and a dielectric breakdown strength device were evaluated as lubricant monitoring devices. In Tasks IV and V, an assessment of the literature on lubricant load carrying capacity (LCC) test methods was made. In Task VI, a software system was developed and implemented on the Zenith Z-100 microcomputer for storage, retrieval and correlation of MIL-L-7808 lubricant qualification data. In Task VII, the remaining useful life of a lubricant evaluation rig (RULLER) was developed for MIL-L-7808 and MIL-L-23699 type lubricants and was based on reductive cyclic voltammetry. (FR)

51719 (DOE/PC/88827–T3) **Thermal stability of jet fuel: Quarterly report, April–June 1989.** Eser, S.; Perison, J.; Copenhaver, R.M.; Schobert, H.H. Pennsylvania State Univ., University Park, PA (USA). Coll. of Earth and Mineral Sciences. [1989]. 23p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88827. Order Number DE90001160. Available from NTIS, PC A03/MF A01 - OSTI.

The overall objective of this program is to investigate the effect of chemical components on the thermal stability of jet fuel. Specific objectives include the determination of the high temperature thermal stability of a suite of model compounds typical of those present as trace contaminants in the fuel, investigation of the thermal stability of various fractions of a coal-derived and a petroleum-derived JP-8 jet fuel, the determination of the thermal stability of the unfractionated fuels, and the development of the relationship between the stability of the whole material and the behavior of model compounds of fuel fractions. 6 figs., 3 tabs.

0206 Health and Safety

Refer also to citation(s) 52341

0207 Marketing and Economics

Refer also to citation(s) 52373, 52416

51720 (DOE/EIA–0380(89/05)) **Petroleum marketing monthly, May 1989.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. 4 Aug 1989. 185p. Sponsored by U.S. DOE Management & Administration. Order Number DE90001526. Available from NTIS, PC A09/MF A01 - GPO - OSTI; GPO Dep.

The Petroleum Marketing Monthly (PMM) is designed to give information and statistical data about a variety of crude oils and refined petroleum products. The publication provides statistics on crude oil costs and refined petroleum products sales for use by industry, government, private sector analysts, educational institutions, and consumers. Data on crude oil include the domestic first purchase price, the f.o.b. and landed cost of imported crude oil, and the refiners' acquisition cost of crude oil. Sales data for motor gasoline, distillates, residuals, aviation fuels, kerosene, and propane are presented. 12 figs., 49 tabs.

51721 (DOE/EIA–0380(89/07)) **Petroleum marketing monthly, July 1989.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. 4 Oct 1989. 185p. Sponsored by U.S. DOE Management & Administration. Order Number DE90001473. Available from NTIS, PC A09/MF A01 - GPO - OSTI; GPO Dep.

The Petroleum Marketing Monthly (PMM) is designed to give information and statistical data about a variety of crude oils and refined petroleum products. The publication provides statistics on crude oil costs and refined petroleum products sales for use by industry, government, private sector analysts, educational institutions, and consumers. Data on crude oil include the domestic first purchase price, the f.o.b. and landed cost of imported crude oil, and the refiners' acquisition cost of crude oil. Sales data for motor gasoline, distillates, residuals, aviation fuels, kerosene, and propane are presented. 12 figs., 55 tabs.

51722 (DOE/EIA–0487(88)) **Petroleum marketing annual 1988.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. 11 Oct 1989. 410p. Sponsored by U.S. DOE Management & Administration. Order Number DE90001650. Available from NTIS, PC A18/MF A01 - GPO - OSTI; GPO Dep.

The petroleum Marketing Annual (PMA) contains statistical data on a variety of crude oils and refined petroleum products. The publication provides statistics on crude oil costs and refined petroleum products sales for use by industry, government, private sector analysts, educational institutions, and consumers. Data on crude oil include the domestic first purchase price, the free-on-board (f.o.b.) and landed cost of imported crude oil, and the refiners' acquisition cost of crude oil. Sales data for motor gasoline, distillates, residuals, aviation fuels, kerosene, and propane are presented. For this publication, all estimates have been recalculated since their earlier publication in the Petroleum Marketing Monthly (PMM). These calculations made use of additional data and corrections that were received after the PMM publication dates. 11 figs., 49 tabs.

0209 Environmental Aspects

51723 The reality of the greenhouse effect. MacCracken, M.C. (Atmospheric and Geophysical Sciences Div., Lawrence Livermore National Lab., Livermore, CA (US)). pp. 283 of Proceedings of the twelfth world petroleum congress. Water Pollution Control Federation, Washington, DC (1987). (CONF-870414--: 12. world petroleum congress, Houston, TX (USA), 26 Apr - 1 may 1987).

The Earth's surface absorbs solar radiation, to which the atmosphere is mostly transparent, and re-emits infrared radiation that is absorbed primarily by carbon dioxide and water vapour. Without the consequent warming, or greenhouse effect, the Earth's mean surface temperature of 15^{0}C would be well below freezing. Changes in the concentration of CO_2 and other greenhouse gases can perturb the present climate. Theoretical models constructed to generate quantitative estimates of these changes suggest that a doubling of the CO_2 concentration could raise global-average temperatures by 1.5 to 4.5^{0}C. Global temperatures appear to have risen about 0.5^{0}C over the past hundred years, in part probably to the 25% rise in CO_2 concentration. There are important questions, however, regarding the rate and history of the warming and the spatial pattern of the changes. The projected climatic changes could induce significant societal impacts, especially if society is viewed as unresponsive. Sea level rise, reduced water resources, and stressed agricultural systems may be the most important consequences, but uncertainties in the estimated climatic effects and the long lead time make assessment difficult. Developing and evaluating options for slowing the rate and the magnitude of and adapting to the projected changes require accelerated research.

0230 Properties

Refer also to citation(s) 53188, 53189

51724 (NIPER–322) **Analysis of heavy oils: Method development and application to Cerro Negro heavy petroleum detailed separation and analysis of acidic compounds.** Green, J.B.; Yu, S.K.T.; Green, J.A.; Doughty, D.A.; Vogh, J.W.; Grigsby, R.D. National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA). Oct 1989. 158p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FC22-83FE60149. Order Number DE89000769. Available from NTIS, PC A13/MF A01 - OSTI; GPO Dep.

An HPLC method for fractionation of whole acid concentrates into nominal compound class subfractions is described. The method utilizes silica columns and gradient elution with eluents containing a strong base, tetramethyl-ammonium hydroxide. The performance of the method is evaluated through analysis of subfractions obtained from a coal liquid, Wilmington, CA, petroleum and Cerro Negro heavy oil. Methods developed specifically for analysis of whole acid concentrates and subfractions are described in detail. These include: (1) an infrared method for determination of total hydroxyl and carboxyl groups after their conversion to trifluoroacetate and 2,2,2-trifluoresters, respectively. (2) an NMR method for functional group analysis based on methylation of acidic groups with ^{13}C-enriched methyl iodide, (3) a nonaqueous titration procedure employing the potassium salt of dimethyl sulfoxide as a titrant for acidic compounds, (4) GC/MS analysis of hydroxyaromatic compounds after their conversion to trifluoroacetate esters, and (5) probe microdistillation high resolution mass spectrometric analysis of acid fractions exhibiting low volatility. 146 refs., 38 figs., 27 tabs.

51725 (NIPER–437) **[National Institute for Petroleum and Energy Research]: Volume 1, Fuels research: Quarterly technical report, July 1–September 30, 1989.** National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA). 12 Oct 1989. 22p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FC22-83FE60149. Order Number DE90001419. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Fuels research is described in the following areas: development of analytical methodology for analysis of heavy crudes; thermochemistry and thermophysical properties of organic nitrogen-, and diheteroatom-containing compounds; and in situ hydrogenation. 3 figs., 6 tabs.

0250 Combustion

Refer also to citation(s) 53188, 53189

51726 Propene oxidation at low and intermediate temperatures. Wilk, R.D. (Drexel Univ., Philadelphia, PA (USA). Dept. of Mechanical Engineering); Cernansky, N.P.; Pitz, W.J.; Westbrook, C.K. *Combustion and Flame (USA)*, 77(2): 145-170 (Aug 1989).

A detailed chemical kinetic mechanism for propene oxidation is developed and used to model reactions in a static reactor at temperatures of 530-740 K, equivalence ratios of 0.8-2.0, and a pressure of 600 torr. Modeling of hydrocarbon oxidation in this temperature range is important for the validation of detailed models to be used for performing calculations related to automotive engine knock. The model predicted induction periods and species concentrations for all the species and all conditions measured experimentally in the static reactor. Overall, the calculated concentrations of carbon monoxide and acetaldehyde agreed well with those measured. The calculated concentrations of ethene are low compared to the experimental measurements, and the calculated concentrations of the formaldehyde are high. Agreement for concentrations of carbon dioxide, methane, methanol, acrolein, and propene oxide is mixed. The characteristic s-shape of the fuel concentration history is well predicted. Modeling calculations identified some of the key reaction steps at the present conditions. Addition of OH to propene and H-atom abstraction by OH from propene are important steps in determining the subsequent distributions of intermediate products, such as acetaldehyde, acrolein and formaldehyde. Allyl radicals are very abundant in propene oxidation, and the primary steps found to be responsible for their consumption are reaction with HO_2 and CH_3O_2.

03 NATURAL GAS

51727 (PB–89-217947/XAB) **Physical Sciences program area: 1989 contract status report.** Gas Research Inst., Chicago, IL (USA). Jul 1989. 277p. (GRI–89/0164). Available from NTIS, PC A13/MF A01.

See also PB–88-161005.

The report summarizes the research contracts funded and managed by the GRI's Physical Sciences Department. Thirteen research areas are grouped according to the elements of GRI's mission: Gas-Supply Options, End Use, Gas Operations, and Crosscutting Research. The description of each contract includes the reasons for funding the research, its objectives, and a statement of accomplishments.

0302 Geology and Exploration

51728 (PB–89-214068/XAB) **Petrophysical properties and network models of gas-bearing reservoir rocks. Annual report, October 1, 1987-November 30, 1988. Technical report.** Nur, A.; Nolen-Hoeksema, R. Stanford Univ., CA (USA). Dept. of Geophysics. 30 Nov 1988. 77p. Available from NTIS, PC A05/MF A01.

Studies of the effect of clay on acoustic velocities in shaley sandstones indicate that clay's influence on rock properties is dominated by its structural position, either as a pore-filling constituent or an integral part of the framework. The authors proposed an isostrain relation to explain the influence of clay on acoustic velocity. A new image-analysis algorithm, called Cederberg-Sobel scanning, was developed to define the connected pathways for fluid flow from a thin section or for geological-feature classification. Connected or isolated features of a 2-D image are extracted within a single scanning pass. Image heterogeneity is transformed into a network and the data are coded into a matrix of nodes, connections and quality of connections. An experimental apparatus has been designed and built to measure the acoustic velocity and attenuation anisotropy in rock.

0303 Drilling, Production, and Processing

Refer also to citation(s) 51717, 52415

0304 Products and By-products

51729 (HESS–8801, pp. 34-38) **Development and research of a LNG engine operated by supplying oxygen enriched air.** Shimizu, Yoshiaki (Suzuki Motor Co., Ltd., Shizuoka (Japan)); Hachisu, Yoshihiro; Maeda, Tadamasa. Hydrogen Energy System Society, Tokyo (Japan). 17 Nov 1988. (In Japanese). (CONF-8811261–: 9. conference on researches on hydrogen energy system, Tokyo (Japan), 17 Nov 1988). In *Proceedings of the 9. conference on researches on hydrogen energy system.* Order Number DE89772184. Available from NTIS (US Sales Only), PC A03/MF A01.

A LNG engine operated by supplying oxygen enriched air was studied. When LNG is gasified, its density becomes lower and fuel occupancy rate in the stroke volume becomes higher, and so volmetric efficiency is abated. As moles are not increased before and after combustion like gasoline, the internal pressure of the cylinder is kept low. LNG's output is, therefore, 20% less than gasoline's. With the supposition of oxygen enrichment film, oxygen enriched air was supplied by controlling oxygen bombs and plant air in the experiment. With oxygen enriched air, output increased in proportion to oxygen concentration. When the air of 29% oxygen concentration is supplied, the same output as that of gasoline can be secured. When oxygen is enriched, combustion temperature becomes higher but exhaust loss is increased. So fuel combustion rate will not be improved. By raising the compression ratio of LNG and with rarefied combustion, the fuel consumption rate was increased by 16%. In the use of LNG, supply fluctuations occurred because of valve recession and of LNG vaporization. For the practical use of the engine, 11.5 compression ratio, 29% oxygen concentration and 0.95 air excessive rate are the best values. 2 references, 9 figures, 3 tables.

0305 Health and Safety

Refer also to citation(s) 52341

0308 Environmental Aspects

51730 (DOE/EA–0409) **National fuel gas supply corporation.** Federal Energy Regulatory Commission, Washington, DC (USA). Office of Pipeline and Producer Regulation. Aug 1989. 27p. Sponsored by U.S. DOE Environment Health & Safety. Order Number DE90001111. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

National Fuel would construct approximately 12.3 miles of 24-inch-diameter pipeline in Erie County, New York, and install 3,300 horsepower of compression at its existing Ellisburg Compressor Station in Potter County, Pennsylvania. National Fuel seeks to commence the proposed transportation on or about November 1, 1987. Therefore, the proposed pipeline would need to be in place by November 1987. The addition to the Ellisburg Compressor Station would be placed in service during 1988. The proposed 12.3-mile-long pipeline would be located in the towns of Lancaster, Elma and Marilla. National Fuel already owns a strip of land in fee up to 115 feet in width that would be used for about 8.9 miles of the proposed route. National Fuel also has under lease about 1.7 miles of the route nd only needs to acquire about 1.7 miles of additional right-of-way. See appendix A for maps of the proposed route. National Fuel would clear a 66-foot-wide construction right-of-way. It is National Fuel's general right-of-way policy for land leased and owned in full to secure a width of between 100 and 115 feet. The pipeline would be located in the Erie Ontario Plain physiographic region. This area is the remnant of an ancient physiographic region. The relief along the pipeline route is slight. Most of the soils crossed by the pipeline have formed from different types of deposits left as a result of glaciation. As a result of these glacial deposits, most of the soils crossed are deep (greater than 60 inches) to bedrock.

0320 Transport, Pipelines, and Handling

Refer also to citation(s) 51730

0330 Properties

Refer also to citation(s) 51728

51731 (PB–89-204358/XAB) **Marine geochemistry of methane. Doctoral thesis.** Scranton, M.I. Woods Hole Oceanographic Institution, MA (USA). Apr 1978. 255p. (WHOI–78-32). Available from NTIS, PC A12/MF A01.

It has been known for several years that the ocean and atmosphere are not at equilibrium with respect to the distribution of methane. The processes maintaining disequilibrium include both biological production and consumption and physical processes such as advection and diffusion. In coastal regions where density stratification is strong, advective transport of methane below the mixed layer appears to be adequate to balance methane loss across the air-sea interface. In the mixed layer itself, however, both in some coastal and in open ocean regions, in-situ biological production appears to be a major source of excess methane. Laboratory experiments have shown that algal metabolism may produce trace amounts of methane. Other possible sources are heterotrophic bacteria and methane bacteria present within reducing microenvironments in the mixed layer. Methane oxidation may also occur within the mixed layer, but no information is available about this.

0340 Combustion

Refer also to citation(s) 51729

0350 Storage

51732 (LBL–27274) **Aqueous foams for control of gas migration and water coning in aquifer gas storage.** Persoff, P.; Pruess, K.; Benson, S.M.; Wu, Y.S.; Radke, C.J.; Witherspoon, P.A.; Shikari, Y.A. Lawrence Berkeley Lab., CA (USA). May 1989. 15p. Sponsored by Gas Research Institute. DOE Contract AC03-76SF00098. (CONF-891111–1: International gas research conference, Tokyo (Japan), 6-9 Nov 1989). Order Number DE89014882. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Two causes of poor recoverability are migration of stored gas far from the injection well and upward coning of water into withdrawal wells. We conducted laboratory and numerical simulation investigation of the use of aqueous foams to block the flow of gas or liquid to ameliorate these problems. Experiments in sandstone cores at simulated reservoir conditions showed that foam reduces the permeability to gas and liquid by three orders of magnitude. A numerical simulation study showed that water coning could be significantly delayed by placing a horizontal foam lens just above the gas-water interface. We also discuss the conditions for forming foam in situ, the feasibility of emplacing a foam bank, and the durability of permeability reduction. Laboratory experiments and numerical simulation indicate potential for significantly improving the efficiency of aquifer gas storage with aqueous foams. A field trial of foam to prevent water coning is recommended. 10 refs., 12 figs., 1 tab.

04 OIL SHALES AND TAR SANDS

0404 Oil Production, Recovery, and Refining

51733 (UCRL–99776) **A detailed kinetic and thermodynamic model of petroleum formation, destruction, and expulsion.** Burnham, A.K.; Braun, R.L. Lawrence Livermore National Lab., CA (USA). Sep 1989. 31p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-7405-ENG-48. (CONF-890920–1: 14. international conference on organic geochemistry, Paris (France), 18-22 Sep 1989). Order Number DE90000830. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A variety of laboratory experiments, including programmed micropyrolysis, isothermal fluidized-bed pyrolysis, oil evolution from a self-purging reactor, pyrolysis-mass spectrometry, and hydrous pyrolysis are analyzed to derive chemical kinetic expressions for pyrolysis of lacustrine and marine kerogens. These kinetic parameters are incorporated into an improved, detailed chemical-kinetic model

which includes oil and gas generation from kerogen, oil degradation by coking and cracking, gas generation from residual kerogen, and hydrogen consumption reactions. Oil is described by eleven boiling-point fractions. The model includes equation-of-state calculations of vapor/liquid equilibria and PVT behavior. The model can be run for closed, open, and leaky systems, and the open system can include an inert-gas purge. The porosity is calculated for both unconstrained conditions as well as conditions simulating natural compaction and fracturing during sedimentary burial. Model calculations are compared to results from a variety of laboratory experiments, including hydrous pyrolysis. Oil expulsion efficiencies and properties are also calculated for a variety of geological conditions. The relative amounts of water and hydrocarbon phase(s) expelled are governed by saturation-dependent relative permeabilities. Gas-oil ratios in the expelled petroleum are related to organic content and geological heating rate. 49 refs., 10 figs., 4 tabs.

0405 Properties and Composition

Refer also to citation(s) 51693

0406 Direct Uses and By-products

51734 (DOE/MC/21353–2669) **Shale oil specialty markets: Screening survey for United States applications.** EG and G Washington Analytical Services Center, Inc., Morgantown, WV (USA); Sinor (J.E.) Consultants, Inc., Niwot, CO (USA). Dec 1987. 107p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-85MC21353. Order Number DE89000948. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

EG and G requested J. E. Sinor Consultants Inc. to carry out an initial screening study on the possibilities for producing specialty chemicals from oil shale. Raw shale oil is not an acceptable feedstock to refineries and there are not enough user of heavy fuel oil in the western oil shale region to provide a dependable market. The only alternatives are to hydrotreat the oil, or else ship it long distances to a larger market area. Either of these alternatives results in a cost penalty of several dollars per barrel. Instead of attempting to enter the large-volume petroleum products market, it was hypothesized that a small shale oil facility might be able to produce specialty chemicals with a high enough average value to absorb the high costs of shipping small quantities to distant markets and still provide a higher netback to the plant site than sales to the conventional petroleum products market. This approach, rather than attempting to refine shale oil or to modify its characteristics to satisfy the specifications for petroleum feedstocks or products, focuses instead on those particular characteristics which distinguish shale oil from petroleum, and attempts to identify applications which would justify a premium value for those distinctive characteristics. Because byproducts or specialty chemicals production has been a prominent feature of oil shale industries which have flourished for periods of time in various countries, a brief review of those industries provides a starting point for this study. 9 figs., 32 tabs.

0408 Marketing and Economics

Refer also to citation(s) 51734

05 NUCLEAR FUELS

51735 (DOE/EIA–0436(89)) **World nuclear fuel cycle requirements 1989.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 19 Oct 1989. 82p. Sponsored by U.S. DOE Management & Administration. Order Number DE90001286. Available from NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.

This analysis report presents the projected requirements for uranium concentrate and uranium enrichment services to fuel the nuclear power plants expected to be operating under two nuclear supply scenarios. These two scenarios, the Lower Reference and Upper Reference cases, apply to the United States, Canada, Europe, the Far East, and other countries in the World Outside Centrally Planned Economic Areas (WOCA). A No New Orders scenarios is also presented for the Unites States. This report contains an analysis of the sensitivities of the nuclear fuel cycle projections to different levels and types of projected nuclear capacity, different enrichment tails assays, higher and lower capacity factors, changes in nuclear fuel burnup levels, and other exogenous assumptions. The projections for the United States generally extend through the year 2020, and the WOCA projections, which include the United States, are provided through 2010. The report also presents annual projections of spent nuclear fuel; discharges and inventories of spent fuel. Appendix D includes domestic spent fuel projections through the year 2020 for the Lower and Upper Reference cases and through 2036, the last year in which spent fuel is discharged, for the No New Orders case.

0501 Reserves, Exploration, and Mining

51736 (CNIC–00192) **Double-layer structure model of the uranium generating bed in the land basins of the northwestern China and its significance.** Wang Zhilong. China Nuclear Information Centre, Beijing, BJ (China). Apr 1988. 9p. (In Chinese). Order Number DE90604721. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The paper puts forward a double layer structure model of uranium generating bed in the land basins of Northwestern China, i.e. uranium ganerating bed = source layer of uranium+gathering uranium layer. The mechanism of its formation: Feldspar was hydromicatized. Some feldspar, quarts detrital silicate minerals were replaced to redden by the authigenesis of hematite and goethite. In the course of the oxidation, a little uranium is released from the detrital minerals. Because of the oxidation environment, the released uranium wasn't able to be precipitated, only to diffuse to the adjacent grey bed which has low Eh value with uranium-bearing 'stagnant water' fixed in pores during the dewatering process of the diagenesis and form minable uranium deposit. The significance of the model for uranium prospecting are as follows: (1) Uranium source range is much expanded concerning ruanium prospecting in sandstone. (2) For the potential assessment of basin and the selection of potential area, the model is an important prospecting criterion. (3) By using the main criterion uranium-generating bed-arkosic red beds well, the buried ore bodies can be found provided that arkosic red beds were regarded as a significant criterion of uranium-generating bed.

51737 (CNIC–00221) **Lithogenesis and evolution of granites and their roles in the uranium-mineralization at LSS area of north-west China.** Hu Junzhen; Chai Baomin; Zhang Jujie. China Nuclear Information Centre, Beijing, BJ (China). May 1988. 6p. (In Chinese). Order Number DE90604722. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The geological development in Precambrian, the evolution of Qi-Liang rift and the lithogenesis and evolution of the granites has played an important role in the formation of the uranium metallogenetic zone at LSS area. The evolution of metallogenetic hydrothermalism and uranium metallogeny in different places and time are presented in this paper. The author has suggested that the alkalic metasomatic uranium deposits belong to the type of migmatic magma-hydrothermal solutions generated by reequilibrations happened in granite sources, and the pegmatitic granite uranium deposits are the multistage, multigenesis and multisource deposits. The conclusion is that there are two important metallogenetic series and patterns at LSS metallogenetic zone.

51738 (INIS-BR–1656) **Scintilometry in pegmatites of the region of Cristais.** Marinho, J.M.L. Sociedade Brasileira de Geologia, Recife, PE (Brazil). Nucleo do Nordeste. 1981. 11p. (In Portuguese). (CONF-8111245–: 10. Symposium of Geology in Northeast, Recife (Brazil), Nov 1981). Order Number DE90606373. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The objective of this paper is to show the use of cintilometry in the delimitation of pegmatites of the region of Cristais, northeast of Ceara State. It is a part of the Project Litium-Ce and it receives a financial aid from FINEP. Four on-the-spot surveys have been made with a rectangules 5 x 15 m mesh on heterogeneous and little or not exploited pegmatite revealed on the surface by a residual mantle of milky quartz and slabs of muscovite. A cintilometer Saphyro

Srat, model SPP-2 was used for readings in counts per second (c/s). Three of the surveys were performed on medium-sized pegmatites (5 - 15 m of width) and show that their measurement are in the 15-60 c/s range while those on the host rock (biotite-gneiss) vary from 70 to 130 c/s. One of the surveys was made over a pegmatitic dyke, with 1,5 meter width, in a sand-covered area of 1 meter, and it shows that the portion of the pegmatite may hardly by suggested, pointing out only at the southwest corner of the area the presence of biotite-gneiss through the increase in the readings. The cintilometry may be used on a more detailed scale in areas with superficial signs of the presence of pegmatites, in order to determine their position and to guide a superficial prospection. The low value reading (15 - 60 c/s) on the pegmatites are bound to be related to the absence of U and Th minerals and to the presence of a nucleus of quartz and albite, replacing largely the potassium feldspars. The reading in the 70 - 130 c/s range on the biotite-gneiss should be linked with the presence in their mineralogic composition of biotite muscovite, potassium feldspars and zircon. A sandy corer disguises the anomalies. (author).

0505 Uranium Enrichment

Refer also to citation(s) 51880, 51894, 51895, 51896, 51899, 51912, 51914, 52324, 52732

51739 (JAERI-M–89-059) **Dynamic behavior and control of product enrichment in a centrifuge cascade. A study of the process simulation as a basis of safeguards design.** Okamoto, Tsuyoshi; Suzuki, Atsuyuki; Nishimura, Hideo. Japan Atomic Energy Research Inst., Tokyo (Japan). May 1989. 24p. Order Number DE90709979. Available from NTIS (US Sales Only), PC A03/MF A01.

It was agreed as a conclusion of the HEXAPARTITE project that a limited frequency unannounced access (LFUA) inspection should be carried out in a centrifuge type enrichment plant as a basic safeguards approach. It might be adopted at a large scale, future commercial enrichment plant, too. Application of the LFUA approach to such a plant, however, should be fully investigated because the plant will have not only a larger capability of enriching uranium 235 but also a more sensitive information to be protected from the commercial and non-proliferation viewpoint. As a part of a design study on the safeguards approach for a model commercial plant, a study of process simulation of the plant has been carried out. This report describes a result of the study. When a commercial uranium enrichment plant is constructed, a nuisance problem arises; What kind of products should be produced from the plant in order to match a wide range of nuclear fuel enrichment requirements for light-water power reactors. In this report, a reasonable solution to such a problem is investigated. At first, a transient analysis of start-up for a model centrifuge cascade is made by using the dynamic equations, which were so developed as to be able to accurately compute interstage flow rates and enrichment in a transient state. Then it is investigated how wide in its acceptable range the product enrichment can be controlled by regulating cascade characteristic parameters such as cascade cut, recycle flow rate and cascade feed flow rate, and as a result an information about the optimal regulating mode is brought out. As a result of this study, it has become clear that the specific requirements of a customer are almost fulfilled with only one type of unit cascade system if 10 % loss of cascade efficiency is allowed in the plant operation. (author).

51740 **Enrichment: Dealing with overcapacity.** Peterson, C.H. *Transactions of the American Nuclear Society (USA),* 58: 77-82 (1989). (CONF-8810179–: International conference on nuclear fission: fifty years of progress in energy security, Washington, DC (USA), 30 Oct - 4 nov 1988).

Today's surplus of enrichment capacity will continue until at least the end of this century. This will challenge the ingenuity of the separative work unit (SWU) suppliers as they attempt to keep market share and remain profitable in a very competitive marketplace. The utilities will be faced with attractive choices, but making the best choice will require careful analysis and increased attention to market factors. Current demand projections will probably prove too high to the extent that more reactors are canceled or delayed. The DOE has the vast majority of the unused capacity, so it will feel the most immediate impact of this large surplus in productive capacity. The DOE has responded to these market challenges by planning another reorganization of its enriching operations. Without a major agreement among the governments affected by the current surplus in enrichment capacity, the future will see lower prices, more competitive terms, and the gradual substitution of centrifuge or laser enrichment for the gaseous diffusion plants. The competition that is forcing the gaseous diffusion prices down to marginal cost will provide the long-term price basis for the enrichment industry.

0507 Fuels Production and Properties

Refer also to citation(s) 51875, 51889, 51906, 51911, 51912, 51914, 51930, 51932, 51942, 51944, 52285, 52384, 53797, 53798, 53799, 53802, 53805, 53807, 53808, 53812, 53813, 53814, 53815, 53817, 53818

51741 (K/ITP–181) **Liquid-phase compositions from vapor-phase analyses: VI, Preliminary comparisons of calculations with experimental data on ClOsub 2F, CClFsub 2CClFsub 2, SFsub 6, and COsub 2.** Davis, W. Jr.; Cochran, H.D.; Leitnaker, J.M. Oak Ridge Gaseous Diffusion Plant, TN (USA). International Technology Programs Div. Sep 1989. 37p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OT21400. Order Number DE90001012. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In the safe handling and processing of uranium hexafluoride (UF_6), it is often desirable to calculate vapor composition and pressure from known liquid composition and temperature. Furthermore, the ability to use analyses of equilibrium vapor-phase samples to calculate liquid-phase compositions would be economically advantageous to the International Atomic Energy Agency (IAEA) in its international safeguards program and to uranium enrichment operators. The latter technique is projected to save the IAEA on the order of $1500 or more per sample. Either type of calculation could be performed with a multicomponent vapor-liquid equilibrium (VLE) model if this model were shown to apply to UF_6 and its common impurities. This report is concerned with the distribution of four potential impurities in UF_6 between liquid and vapor phases. The impurities are carbon dioxide, sulfur hexafluoride, chloryl fluoride, and Freon-114 ($CClF_2CClF_2$). There are no binary equilibrium data on the first three of these impurities; hence, the VLE calculations are based entirely on the thermodynamic properties of the pure components. There are two sets of binary equilibrium data for the system Freon-114-UF_6 that are analyzed in terms of the model of Prausnitz et al. Calculations based on these data are compared with those based solely on the thermodynamic properties of pure Freon-114 and pure UF_6. 23 refs., 3 figs., 5 tabs.

51742 (LA-UR–89-2712) **In situ measurements of neutron multiplying systems.** McLaughlin, T.P. Los Alamos National Lab., NM (USA). [1989]. 6p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. (CONF-891118–7: International meeting on nuclear criticality safety margins, San Francisco, CA (USA), 26 Nov - 1 dec 1989). Order Number DE89017000. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Historical and recent examples of the application of in situ measurements to provide knowledge for specific operations and general criticality safety guidance are reviewed. The importance of the American National Standard, Safety in Conducting Subcritical Neutron-Multiplication Measurements In Situ, ANSI/ANS-8.6, 1988 is discussed. Examples of possible future applications of in-situ measurements are provided. 4 refs., 4 figs.

51743 (WSRC-RP–89-81) **Chlorine demand of Savannah River water.** Wilde, E.W. Westinghouse Savannah River Co., Aiken, SC (USA). 1989. 28p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. Order Number DE90001377. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Savannah River water used for cooling SRS reactors was tested for chlorine demand and the rate of decay for both free and total residual chlorine on seven quarterly dates between 1986 and 1988. Test conditions included chlorine dosages of 1, 3, and 5 mg/l and a variety of contact times ranging from less than 1 minute to one day.

Statistically significant differences were detected in the chlorine demand for the seven dates; however, there was no discernible seasonality to the variation. The chlorine demand, amount of combined residual chlorine formed and the persistence of total residual chlorine following a dose of 5 mg/l was significantly greater on one of the seven sampling dates (February, 1988) compared to all of the other dates. These differences could not be attributed to water temperature, pH, ammonia nitrogen concentration, or the amount of rainfall prior to or during the collection of the cooling water. Except as noted above, dissipation of chlorine was similar among the sampling dates. Most reactions of available chlorine with other constituents in the cooking water occurred in the first minute of contact, although measurable total chlorine residuals generally persisted for 24 hours after the dose had been administered. The results of this study indicate that, with occasional exceptions, a chlorine dose of between 3 and 5 mg/l will provide a free chlorine residual of 1 mg/l in Savannah River water. 14 refs., 3 figs., 4 tabs.

0508 Spent Fuels Reprocessing

Refer also to citation(s) 51872, 51873, 51878, 51881, 51885, 51890, 51891, 51892, 51900, 51902, 51904, 51906, 51908, 51910, 51911, 51912, 51913, 51914, 51915, 51916, 51917, 51919, 51920, 51921, 51929, 52167, 52231, 52407, 52890, 53204

51744 (ENEA-RT-COMB–88-04) **Extraction of liquid state actinides by dibutyl-N, N-diethylcarbamylphosphonate (DBDECP).** Spezzano, P.; Giacomelli, R.; Sarzanini, C.; Volpe, P.; Benzi, P. ENEA, Casaccia (Italy). Dipt. Ciclo del Combustibile. Sep 1988. 42p. (In Italian). Order Number DE89793108. Available from NTIS (US Sales Only), PC A03/MF A01.

The removal of actinides from nuclear fuel reprocessing waste solutions was examined. The extraction of Th(IV), U(VI), Pu(IV), Am(III) and Cm(III) by dibutyl-N, N-diethylcarbamylphosphonate (DBDECP) from nitric, hydrochloric and perchloric acid solutions was studied as a function of a number of parameters. The effect of size and structure of the extractant molecules was investigated for lower homologues of carbamylphosphonate. After evaluating the effect of the diluent, the extraction of inorganic acid HNO_3, HCl and $HClO_4$ and the dependence of the distribution ratios of the actinides on organic extractant concentration and aqueous acid concentration were studied for the DBDECP-xylene system.

51745 Electrochemical uranium valence control in centrifugal solvent extraction contactors. Schneider, A.; Pschirer, D.M. *Transactions of the American Nuclear Society (USA),* 56: 85-87 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

In the Purex process for the reprocessing of spent nuclear fuel, the partitioning of uranium and plutonium generally requires a reducing agent for the valence change of Pu(IV) to Pu(III). Modified mixer-settlers and pulsed columns with internal electrodes have been developed for the simultaneous electroreduction and solvent extraction, and the utility of this partitioning method has been demonstrated for the reprocessing of light water reactor and fast breeder reactor (FBR) fuels. Short-residence solvent extraction contractors are needed for the reprocessing of high-burnup fuels to reduce the radiation damage to the organic solvent. Centrifugal contactors, the currently preferred machines, have inherent spatial limitations for the incorporation of electrodes. External electrolytic reduction cells could be used, provided the chemical stability of the reduced species [U(IV) and Pu(III)] can be assured. The feasibility of in-tandem operation of a multistage centrifugal contactor and an electrolytic reduction cell was investigated, and the applicability of this method to the reprocessing of FBR fuel was tested by means of computer models developed from experimental results.

0509 Transport and Storage

Refer also to citation(s) 51807, 52169, 52175, 52297, 52550, 52884, 52885, 52886

51746 Remote cask handling and implications for cask system design. Griesmeyer, J.M. *Transactions of the American Nuclear Society (USA),* 56: 105-106 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Robotic handling of nuclear waste shipping casks has the potential to significantly reduce occupational radiation exposure. Furthermore, robot programmability can provide a detailed paper trail for quality assurance, and computer monitoring of operator interactions with the system can improve safety. This paper discusses the impact of cask design of the potential application of robotic systems to repository-based nuclear waste shipping cask handling operations. The main conclusions are as follows: 1. Cask system design can greatly facilitate robotic cask handling with minimal impact of cask functional features. 2. Proper cask design allows robotic cask handling operations form unbolting tiedown straps to radiation surveys to be performed quickly and reliably without direct human intervention. 3. Design for remote handling also facilitates manual handling operations.

51747 Technical issues relevant to the transport of commercially generated high-level nuclear waste in the United States. Sanders, T.L.; Allen, G.C. Jr.; Ottinger, C.A.; Sandoval, R.P.; Dwight, C.C. *Transactions of the American Nuclear Society (USA),* 56: 106-108 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The Office of Civilian Radioactive Waste Management (OCRWM) of the US Department of Energy (DOE) and the US Nuclear Regulatory Commission (NRC) have agreed to pursue the timely resolution of nuclear material packaging issues that affect the transport of waste in the united states under the Nuclear Waste Policy Act of 1982 Sandia National Laboratories (SNL), under the direction of the DOE Idaho Operations Office, is supporting OCRWM in identifying and resolving these technical issues. Given the large number and diversity of casks expected to be used for nuclear waste transportation operations beginning in the late 1990s, the DOE intends to address some high-priority cask technical issues in a timely and assertive manner before the submission of safety analysis reports for individual packages. Open exchanges between DOE and NRC have been initiated on a limited number of issue topics currently being investigated in depth to develop sufficient technical justification to pursue resolution of the issues. These issues are (1) burnup credit, (2) source term containment evaluation, (3) transportable storage casks, and (4) cask weeping.

51748 An analysis of crud contribution to the maximum permissible release rates for reactor spent-fuel shipments. Sandoval, R.P.; Sanders, T.L.; Einziger, R.E.; Malinauskas, A.P.; Mings, W.J. *Transactions of the American Nuclear Society (USA),* 56: 108-109 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Through The Cask Systems Development Project Office at the US Department of Energy (DOE) in Idaho, the DOE Office of Civilian Radioactive Waste Management is sponsoring a program at Sandia National Laboratories to develop standardized methodologies for evaluating spent-fuel shipping packages to the federal containment requirements. An important subtask of the program is the evaluation of the neutron-activated corrosion-product deposits (i.e., crud) on irradiated fuel rod surfaces and the determination of the contribution of these crud deposits to the total activity available for release from cask containment. During transportation, cured may spall from the fuel rods, disperse, and become suspended in the cavity medium (gas or liquid) and could be the major contributor to the total source term. An analysis of all available data on crud deposit activity, concentration distributions, composition, spallation properties, particle size distribution, and crud friability was conducted for various light ware reactor fuels for selected burnups and decay items. Assuming that crud is the only source of activity release, the maximum permissible leakage rates were estimated using these data for seven types of truck and rail shipping casks containing 1- and 10-yr-cooled spent fuel. The details and results of this analysis are presented in this paper.

51749 Development of strain gauge evaluation channels for use in dynamic testing of shipping casks. Uncapher, W.L.; Bronowski, D.R.; Stenberg, D.R. *Transactions of the American Nuclear Society (USA),* 56: 109-110 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The Transportation System Development Department at Sandia National Laboratories (SNL) frequently evaluates the structural response of casks being developed to transport radioactive materials. A major part of this activity includes gathering instrumentation data from dynamic impact tests of cask models. The acquisition of reliable, high-quality instrumentation data is an important component of cask certification. One method to evaluate instrumentation error during testing is to include evaluation channels for the various structural transducers. Evaluation channels have been produced by some manufacturers of accelerometers used for structural evaluations of casks and are commercially available. These particular devices produce very low output or no output to applied shock acceleration. However, it was found that a packaged strain gauge evaluation channel is not commercially available. Consequently, strain gauge evaluation channels have been developed at SNL to evaluate non-strain-induced resistance changes from environmental factors that could affect resistance strain measurement data. These unwanted nonstrain-induced resistance changes could be caused, for example, by resistance changes in the interconnecting cabling, electromagnetic noise, or grounding effects.

51750 Calculation of radiation dose rates from a spent nuclear fuel shipping cask. Chen, S.Y.; Yuan, Y.C. *Transactions of the American Nuclear Society (USA)*, 56: 110-112 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Radiation doses from a spent nuclear fuel cask are usually incurred from various phases of operations during handling, shipping, and storage of the casks. Assessment of such doses requires knowledge of external radiation dose rates at various locations surrounding a cask. Under current practices, dose rates from gamma photons are usually estimated by means of point- or line-source approaches incorporating the conventional buildup factors. Although such simplified approaches may at times be easy to use, their accuracy has not been verified. For example, those simplified methods have not taken into account influencing factors such as the geometry of the cask and the presence of the ground surface, and the effects of these factors on the calculated dose rates are largely unknown. Moreover, similar empirical equations for buildup factors currently do not exist for neutrons. The objective of this study is to use a more accurate approach in calculation radiation dose rates for both neutrons and gamma photons from a spent-fuel cask. The calculation utilizes the more sophisticated transport method and takes into account the geometry of the cask and the presence of the ground surface. The results of a detailed study of dose rates in the near field (within 20 m) are presented and, for easy application, the cask centerline dose rates are fitted into empirical equations at cask centerline distances up to 1000 m from the the surface of the cask.

0510 Marketing, Economics, and By-products

Refer also to citation(s) 52231, 52407

51751 Prospects for the uranium market. Murray, J. *Transactions of the American Nuclear Society (USA)*, 58: 72-76 (1989). (CONF-8810179–: International conference on nuclear fission: fifty years of progress in energy security, Washington, DC (USA), 30 Oct - 4 nov 1988).

The Uranium Institute tries to find reasonably meaningful figures to identify the market for uranium. Reactor requirements are expected to rise by about 12000 tonnes by the year 2000. Actual uranium production has been lower than reactor requirements since the mid-1980s, but a high level of inventory was built up during years of excess production. United States buyers are less concerned about the future security of supplies of uranium than their European and Far Eastern counterparts. The absence of uranium resources results in inevitable dependence on the international market and higher concern with supply security. The higher the level of dependence on nuclear power, the greater becomes the penalty of failing to assure security of supply. The US utility regulatory system has discouraged long term coverage. US buyers are confident that production will respond in a timely fashion when demand calls for it.

0520 Waste Management

Refer also to citation(s) 51747, 51857, 51863, 51864, 51865, 51866, 51867, 51868, 51869, 51870, 51871, 51881, 51906, 52235, 52296, 52297, 52329, 52384, 52396, 52397, 52398, 52407, 52569, 52579, 52659, 52714, 52960, 53274

51752 (AERE-R–12961) **Evolution of pH in a radwaste repository. Leaching of modified cements and reactions with groundwater.** Atkinson, A.; Guppy, R.M. UKAEA Harwell Lab. (UK). Materials Development Div. Jan 1988. 42p. (DOE-RW–89.025(pt.3)). Available from H.M. Stationery Office, London, price Pound 10.00.

Cementitious materials in radioactive waste repositories establish high pH which brings many benefits. The pH will change with time as the chemical constitutents responsible for it are leached away. This has been simulated in the laboratory for a Sulphate Resisting Portland Cement (SRPC), a slag-modified cement composed of 90% Blast Furnace Slag (BFS) and 10% Ordinary Portland Cement (OPC) and an ash-modified cement containing 90% Pulverized Fuel Ash (PFA) and 10% OPC. They have been leached in demineralised water and a synthetic groundwater typical of a clay environment. Leachate analyses for a variety of elements showed that the leachate was not usually in equilibrium with any of the solid phases. Nevertheless the experimental evolution of pH was not too different from that predicted by assuming equilibrium and the predictions offer a means of estimating a lower bound for pH as it evolves in a real repository. The experiments with synthetic groundwater showed that the dominant effect influencing pH was precipitation of $CaCO_3$ from bicarbonates in the groundwater resulting in a reduction in both pH and buffer capacity. The ash-modified cement has particularly poor pH-buffering performance which is exacerbated in the groundwater. (author).

51753 (ANL–89/14) **A review of degradation behavior of container materials for disposal of high-level nuclear waste in tuff and alternative repository environments.** Maiya, P.S. Argonne National Lab., IL (USA). Jun 1989. 83p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. Order Number DE90000916. Available from NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.

Corrosion resistance of materials in aqueous system is reviewed from the perspective of their suitability as container materials for nuclear waste. A discussion of the chemistry and characterization of repository environments, namely, tuff and alternative environments (shale, limestone, and carbonate), is followed by a description of corrosion mechanisms. In this review, emphasis is placed on localized corrosion (e.g., stress corrosion cracking, crevice corrosion, and pitting) because localized corrosion is difficult to account for in design of components, but it is the life-limiting factor for many metallic and nonmetallic systems. The physical metallurgy and microstructure of the potential alloys are briefly described because they provide insight into both the mechanisms of various localized corrosion processes and possible solutions to corrosion problems. A survey of localized corrosion behavior of potential candidate materials as determined by both corrosion and mechanical test in a large number of repository-related environments is presented in order to determine the most promising materials for a given environment. These studies include the effects of various environmental factors (such as pH, temperature, and electrochemical potentials), as well as alloying elements and other microstructural parameters, on corrosion. The modifications of the environment induced by gamma radiation and the stability of the microstructure under gamma irradiation are also described. Although in the majority of cases the tests and the environments used are severe, they point out that metallic materials are generally more promising than nonmetallic materials (ceramic and polymeric materials). 122 refs., 61 figs., 19 tabs.

51754 (CONF-890928–6) **Nevada test site low-level and mixed waste repository design in the unsaturated zone.** Kawamura, T.A.; Warren, D.M. Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA); USDOE Nevada Operations Office, Las Vegas, NV (USA). 1989. 25p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC08-89NV10630. From Nuclear waste isolation in the unsaturated zone: FOCUS '89; Las Vegas, NV (USA); 18-21 Sep 1989. Order Number DE90001016. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The Area 5 Radioactive Waste Management Site (RWMS) at the Nevada Test Site (NTS) is used for shallow land disposal of Low-Level Radioactive (LLW) and for retrievable disposal of Mixed Wastes (MW) from various Department of Energy (DOE) facilities. The site is situated in southern Nevada, one of the most arid regions of the United States. Design considerations include vadose zone monitoring in lieu of groundwater monitoring, stringent waste acceptance and packaging criteria, a waste examination and real-time radiography facility, and trench design. 4 refs.

51755 (CONF-891101–1) **Geology and hydrogeology of the proposed nuclear waste repository at Yucca Mountain, Nevada and the surrounding area.** Mattson, S.R.; Broxton, D.E.; Buono, A.; Crowe, B.M.; Orkild, P.P. Science Applications International Corp., Las Vegas, NV (USA). [1989]. 66p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC08-87NV10576. From Geological Society of America annual meeting; St. Louis, MO (USA); 6-9 Nov 1989. Order Number DE89014542. Available from NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.

In late 1987 Congress issued an amendment to the Nuclear Waste Policy Act of 1982 which directed the characterization of Yucca Mountain, Nevada as the only remaining potential site for the Nation's first underground high-level radioactive waste repository. The evaluation of a potential underground repository is guided and regulated by policy established by the Department of Energy (DOE), Nuclear Regulatory Commission (NRC), Environmental Protection Agency (EPA), Department of Transportation (DOT), and the US Congress. The Yucca Mountain Project is the responsibility of the DOE. The purpose of this field trip is to introduce the present state of geologic and hydrologic knowledge concerning this site. This report describes the field trip. 108 refs., 6 figs., 1 tab.

51756 (DOE/AL/10752–42) **Evaluation of the DOE [Department of Energy] plans for radioactive experiments and operational demonstration at WIPP [Waste Isolation Pilot Plant].** Chaturvedi, L. Environmental Evaluation Group, Albuquerque, NM (USA). Sep 1989. 104p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-78AL10752. (EEG–42). Order Number DE90001211. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

DOE's stated justification for the experiments is to generate reliable data on gas generation from the waste, for use in predicting long-term behavior of the repository conditions. DOE's scientists, responsible for assessing the long-term integrity of the repository by assessing compliance with the EPA Standards, have stated that there are difficulties in meeting such compliance for the breach scenarios involving future drilling into the repository. Gas generation rates greater than 0.1 mole/drum/year appear to create problems for long-term integrity. The best estimates of gas production rates are 25 to 50 times this rate, viz., 2.5 to 5 moles/drum/year. It does not appear likely that the experiments will yield a rate of gas generation low enough to be acceptable for prediction of satisfactory long-term performance of the repository. Part of the problem in making a satisfactory assessment of the validity of the proposed experiments is nonavailability of the procedures used to reach conclusions of potential non-compliance with the EPA Standards. Very high gas pressures predicted in the repository by DOE scientists do not seem to have considered whether several gas generation processes could continue under expected conditions for several hundreds of years. 43 refs., 2 tabs.

51757 (DOE/RL–89-14-Draft-A) **Draft remedial investigation/feasibility study work plan for the 300-FF-5 operable unit, Hanford Site, Richland, Washington.** USDOE Richland Operations Office, WA (USA). Sep 1989. 366p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-87RL10930. Order Number DE90001139. Available from NTIS, PC A16/MF A01 - OSTI; GPO Dep.

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) focuses on waste site cleanups whenever there is a release or substantial threat of release to the environment by a hazardous substance, pollutant, or contaminant. Under such conditions, the US Environmental Protection Agency (EPA) is authorized to undertake removal and/or remedial action. As summarized in EPA guidance documents, a specific process has been established to identify potentially hazardous sites, characterize site contamination, assess treatment technologies, and then design and construct appropriate treatment facilities. An initial activity of the Remedial Investigation/Feasibility Study/Record of Decision (RI/FS/ROD) process is the issuance of a work plan. The work plan for the 300-FF-5 groundwater operable unit on the Hanford Site is the topic of this document. This 300-FF-5 Work Plan is written as an addendum to the 300-FF-1 Work Plan. The 300-FF-5 operable unit consists of the groundwater aquifer beneath the 300-FF-1, 300-FF-2, and 300-FF-3 source operable units and adjacent areas defined by the extent of groundwater contamination (WHC 1989). The outline used in this addendum generally follows that of the 300-FF-1 Work Plan. This addendum is complete in its coverage of all outline sections, but where possible, the 300-FF-1 Work Plan is referenced rather than duplicating major discussions. 119 refs., 47 figs., 35 tabs.

51758 (DP-MS–88-160-Rev.1) **Program for low-level radioactive waste disposal at the Savannah River Site, A U.S. nuclear materials production facility: Revision 1.** Wilhite, E.L.; Cook, J.R.; McDonell, W.R. Westinghouse Savannah River Co., Aiken, SC (USA). 1989. 21p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-891006–6-Rev.1: Joint international waste management conference, Kyoto (Japan), 23-28 Oct 1989). Order Number DE90001381. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An integrated program has been developed for disposal of low-level radioactive wastes and associated mixed (radioactive-hazardous) and transuranic (TRU) wastes generated at the Savannah River Site (SRS). The program, supported by existing as well as new planned facilities, features a systems management approach, in which final disposal sites are specially designed and constructed for appropriately segregated waste streams, and intermediate treatment facilities are provided to reduce volumes and convert wastes to stable forms prior to disposal. Currently-existing shallow land burial facilities are comprehensively monitored for release of contaminants to underlying groundwaters, with only short-lived tritium exhibiting significant migration. Transport modeling is employed to define closure procedures capable of preventing long-term contamination. New facilities to be provided for disposal of the low-level radioactive wastes feature concrete-stabilized wasteforms contained within vault structures that are capable of restricting releases including tritium and other radionuclides to acceptably low levels. Future development studies will center around waste minimization initiatives. 16 refs., 6 figs.

51759 (DP-MS–89-73) **Comparison of unsaturated flow and transport models with volume and nitrate measurements from a pilot-scale, in-situ lysimeter with different geometry low level radioactive waste designs.** Wilhite, E.L.; Lantz, R.B.; McIntyre, P.F.; Statham, W.H.; Longsine, D.E. Westinghouse Savannah River Co., Aiken, SC (USA). [1989]. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-890928–8: Nuclear waste isolation in the unsaturated zone: FOCUS '89, Las Vegas, NV (USA), 18-21 Sep 1989). Order Number DE90001380. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Results from a large-scale field lysimeter experiment containing three thirty-ton monoliths formed from actual decontaminated nuclear waste have been used to validate flow and transport models. The models used are a two-dimensional, finite difference transport and diffusion model. The best match of nitrate concentrations calculated to be released from the monoliths with values observed from the lysimeter occurred with monolith diffusivities in the range of 5×10^{-6} to 2×10^{-5} cm^2/sec and dispersivities ranging from 15 to 65 cm. The validated models have been used to predict the performance of a low-level waste disposal facility at the Savannah River Site. 4 refs., 9 figs.

51760 (GSF–7/89) **Radiation protection and environmental monitoring in the area of the Asse shaft plant. Annual report 1988.** Mueller-Lyda, I.; Meyer, H. Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Jun 1989. 42p. (In German). Order Number DE90711759. Available from NTIS (US Sales Only), PC A03/MF A01.

Personnel monitoring has been carried through in compliance with the Radiation Protection Ordinance. Environmental monitoring

including measurement of local doses, local dose rates, and airborne radioactivity in the shaft has been made according to the provisions for radiation protection at the place of work. Maximum permissible personal doses or activity levels for occupationally exposed persons have not been exceeded in the reporting period. Exhaust air monitoring detected the nuclides H-3, C-14, Pb-210, and the short-lived daughter products of Rn-222 and Rn-220. The activity concentrations in the environment, determined from the measured annual release values, for some part have been lower than the average of natural concentrations of said nuclides. The radiation exposure due to emissions, measured at the least favourable point in the environment, has been far below the limits set by the Radiation Protection Ordinance. In conclusion: The radiation exposure of the personnel and of the population in the area of the Asse shaft plant due to the storage of radioactive is low, compared to the natural radiation exposure. (orig.).

51761 (GSF–12/88) **Stresss measurement in salt strata by means of hydraulic ripping.** Fischle, W.R.; Schwieger, K.; Olffers, M. Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Braunschweig (Germany, F.R.). Inst. fuer Tieflagerung; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Jun 1988. 45p. (In German). Contract BMFT KWA 5702 2;BMFT KWA 5603 6. Order Number DE90711224. Available from NTIS (US Sales Only), PC A03/MF A01.

A series of hydraulic ripping tests were performed in borings of various orientations. Different values were observed for the critical ripping and re-ripping pressure, depending on the pressure increase rate. During slow pressure increases, a larger quantity of liquid could be injected into the rocks, even before a maximum was attained. In this case, the critical value fell by about 10-15%. For this reason, and owing to the inclined three-dimensional situation of the cracks, no pressure gradient could be determined with respect to the critical ripping pressure. Preliminary pressure tests were performed to check the tightness of the system. The comparison of four methods for determining the three-dimensional situation of the cracks revealed a satisfactory agreement of sound emission analysis with underground surveys and surveys with the stratum compass. The packer impression method has, in principle, proved to be inappropriate. Various limits of crack extension from 3.2 to 13.8 m^2, and of crack thickness from 500-1100 μm were determined by varying the quantity of injection liquid between 2 and 15 litres. No time dependence could be observed up to 90 days between borehole completion and test procedures. The drilling direction opted for had no appreciable influence on the results. (orig./HP).

51762 (IPEN-PUB–254) **Characteristics of waste forms improved by using admixtures.** Rzyski, B.M.; Suarez, A.A. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Jun 1989. 20p. Order Number DE90606924. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The immobilization of nitric waste streams with ordinary Portland cement can be improved by use of some admixtures. The aim of this work was to investigated how the main characteristics of waste forms prepared with Portalnd cement pastes are modified by the addition of sulphonic naphtalene acids, lignosulphonic acids and emulsified fatty acids, which are present in some commercial admixtures. The effectiveness of the admixture in reducing the pore volume, as well as improving other parameters, depends on its chemical composition and on the amount utilized as well as the water to cement ratio and salt content. The admixture which has emulsified fatty acids in its composition shows some adverse results when the samples are immersed in water. The mechanical strenght however is some what increased even when water load is increased. (author).

51763 (IPEN-PUB–256) **Techniques of treatment or conditioning for waste arising from ^{131}I production.** Dellamono, J.C. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Jul 1989. 21p. Order Number DE90606894. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Distillation, evaporation/crystallization, direct immobilization and some chemical like precipitation and reduction were studied as techniques of treatment or conditioning for waste arising from ^{131}I production. The description of all techniques studied, as well as evaluation and discussion of the results are presented. (author).

51764 (IPEN-PUB–259) **Forecast of radionuclide release from full size waste forms.** Suarez, A.A.; Rzyski, B.M.; Sato, I.M. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Jul 1989. 20p. Order Number DE90606925. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The complete understanding of the leaching mechanism of radionuclides from solid cementitious waste forms is still far from being reached. Much effort has been devoted, however, to identify and explain the main components which contribute to the dispersal of radionuclides out of the waste form to the environment. This is of prime importance when short term results are extrapolated into the future. The diffusion coefficient evaluation, based on experimental leaching data obtained from samples produced from the same batch was performed using the exact diffusion formulation applied to real geometric sample shape. The laboratory obtained diffusion coefficients are not constant in time nor are they the same for the different samples assayed precluding the use of laboratory scale leaching experiments to forecast the behavior of large scale samples. (author).

51765 (LA–11665-SR) **The Yucca Mountain Project Prototype Testing Program: 1989 Status report.** Los Alamos National Lab., NM (USA). Oct 1989. 32p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract W-7405-ENG-36. Order Number DE90000947. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The Yucca Mountain Project is conducting a Prototype Testing Program to ensure that the Exploratory Shaft Facility (ESF) tests can be completed in the time available and to develop instruments, equipment, and procedures so the ESF tests can collect reliable and representative site characterization data. This report summarizes the prototype tests and their status and location and emphasizes prototype ESF and surface tests, which are required in the early stages of the ESF site characterization tests. 14 figs.

51766 (ORNL–6581) **ORNL underground storage tank management guide.** Payne, T. Oak Ridge National Lab., TN (USA). Sep 1989. 37p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90000967. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Oak Ridge National Laboratory (ORNL) is a multidisciplinary research laboratory operated by Martin Marietta Energy Systems, Inc., for the US Department of Energy. The research conducted at ORNL is primarily directed toward energy research and development. In support of their missions, many ORNL organizations use underground storage tanks (USTs) for liquid-material storage. These USTs, when properly managed, do not threaten our health nor the environment. New federal regulations have been passed to ensure that USTs are properly managed and to protect the environment against releases from USTs. This document provides operating guidelines that are intended to ensure that ORNL organizations comply with those new regulations. 2 tabs.

51767 (ORNL/FTR–3320) **[Methods for expanding spent fuel storage facilities]: Foreign trip report, June 12, 1989–June 15, 1989.** Johnson, E.R. Oak Ridge National Lab., TN (USA). 13 Jul 1989. 255p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC05-84OR21400. Order Number DE89017560. Available from NTIS, PC A12/MF A01 - OSTI; GPO Dep.

During the period June 12-15, 1989 the undersigned attended the meeting of the IAEA Technical Committee on Methods for Expanding Spent Fuel Storage Facilities. This meeting was held at the Vienna International Center in Vienna, Austria. All participants were the specific designees of their respective governments and the role of the undersigned was to participate in the meeting on behalf of the US Department of Energy. A total of 18 persons representing 14 different countries attended the meeting. A listing of the participants and their affiliations has been included in Appendix A of this report. The purpose of the meeting was: (1) to exchange new information on the international level on subjects applicable to the expansion of storage capacities for spent fuel; (2) to define the state-of-the-art for this activity; (3) to define the most important areas for future activity; (4) on the basis of the above information to give recommendations to potential users for selection and application of the most suitable

methods for expanding spent fuel facilities taking into account the relevant country-specific conditions. 10 refs., 20 figs., 2 tabs.

51768 (ORNL/TM–10653) **Filtration of Oak Ridge National Laboratory simulated liquid low-level waste.** Fowler, V.L.; Hewitt, J.D. Oak Ridge National Lab., TN (USA). Aug 1989. 25p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OR21400. Order Number DE90001860. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A method for disposal of Oak Ridge National Laboratory's (ORNL's) liquid low-level radioactive waste (LLLW) is being developed in which the material will be solidified in cement and stored in an aboveground engineered storage facility. The acceptability of the final waste form rests in part on the presence or absence of transuranic isotopes. Filtration methods to remove transuranic isotopes from the bulk liquid stored in the Melton Valley Storage Tanks (MVST) were investigated in this study. Initial batch studies using waste from MVST indicate that >99.9% of the transuranic isotopes can be removed from the bulk liquid by simple filtration. Bench-scale studies with a nonradioactive surrogate waste indicate that >99.5% of the suspended solids can be removed from the bulk liquid via inertial crossflow filtration. 4 refs., 3 figs., 11 tabs.

51769 (ORNL/tr–89/35) **Powdering characteristics of a thin film evaporator: Drying and powdering of a solution.** Chino, Koichi; Yusa, Hideo; Kinoshita, Mitsuo; Horiuchi, Susumu; Hayashi, Masaru. 17p. Translated from Nippon Genshiryoku Gakkaishi (Japan). *Nippon Genshiryoku Gakkaishi (Japan),* 25(1): 69-75 (1983). Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400.

A thin-film evaporator requires only a short heating time to concentrate a solution since it has a high thermal efficiency and has a small capacity. Thus, the chemical industry often uses this type of evaporator for concentrating materials that are subject to the influence of heat, such as fatty acids, rocket fuels, etc. Furthermore, it has a structure that allows a tight seal and is easy to wash. Hence, it is also used in the area of nuclear power for the purpose of concentrating and processing various radioactive liquid wastes. Thin-film evaporators have been used to dry and powder liquid wastes recently in order to further reduce the volume of radioactive liquid wastes. The present study we investigated a solution-powdering process in a thin-film evaporator both experimentally and theoretically. Since a powdering process is a complex phenomenon which is accompanied by phase changes, the operational conditions have been determined by experiments. In order to analyze them theoretically, it is necessary to know the configuration of the liquid film formed by rotating swing blades, the heat transfer between the thermal transfer surface and the liquid film, and powdering by water evaporation. 8 refs., 9 figs.

51770 (PB–89-206171/XAB) **Superfund Record of Decision (EPA Region 6): United Nuclear Corporation, Mckinley County, New Mexico, ground-water operable unit (first remedial action) September 1988.** Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response. 30 Sep 1988. 139p. (EPA/ROD/RO–6-88/044). Available from NTIS, PC A07/MF A01.

Portions of this document are not fully legible.

The United Nuclear Corporation (UNC) site is located approximately 17 miles northeast of Gallup, New Mexico in McKinley County. The site operated as a State-licensed uranium mill facility from June 1977 to May 1982. It includes an ore-processing mill (about 25 acres) and an unlined tailings pond area (about 100 acres). In July 1979, approximately 23 million gallons of tailings and pond water were released to a nearby river as a result of a dam breach in the tailings pond area. The site damage was repaired; however, attention was focused on ground-water contamination resulting from tailings seepage. Nevertheless, the offsite migration of radionuclides and chemical constituents from uranium milling byproduct materials into the ground water, as well as to surface water and air, are still principal threats at the site. The remedial action will address onsite ground water contamination. Source control and onsite surface reclamation will be implemented under the direction of the Nuclear Regulatory Commission and integrated with this ground water operable unit. The primary contaminants of concern affecting the ground water are metals including arsenic, and radioactive substances including radium-226/228 and gross alpha. The selected remedial action for the site is included.

51771 (PNL–6853) **Preliminary testing of turbulence and radionuclide transport modeling in deep ocean environment.** Onishi, Y.; Dummuller, D.C.; Trent, D.S. Pacific Northwest Lab., Richland, WA (USA). Mar 1989. 97p. Sponsored by Environmental Protection Agency. DOE Contract AC06-76RL01830. Order Number DE90000921. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Pacific Northwest Laboratory (PNL) performed a study for the US Environmental Protection Agency's Office of Radiation Programs to (1) identify candidate models for regional modeling of low-level waste ocean disposal sites in the mid-Atlantic ocean; (2) evaluate mathematical representation of the model's eddy viscosity/dispersion coefficients; and (3) evaluate the adequacy of the k-ϵ turbulence model and the feasibility of one of the candidate models, TEMPEST©/FLESCOT©, to deep-ocean applications on a preliminary basis. PNL identified the TEMPEST©/FLESCOT©, FLOWER, Blumberg's, and RMA 10 models as appropriate candidates for the regional radionuclide modeling. Among these models, TEMPEST/FLESCOT is currently the only model that solves distributions of flow, turbulence (with the k-ϵ model), salinity, water temperature, sediment, dissolved contaminants, and sediment-sorbed contaminants. Solving the Navier-Stokes equations using higher order correlations is not practical for regional modeling because of the prohibitive computational requirements; therefore, the turbulence modeling is a more practical approach. PNL applied the three-dimensional code, TEMPEST©/FLESCOT© with the k-ϵ model, to a very simple, hypothetical, two-dimensional, deep-ocean case, producing at least qualitatively appropriate results. However, more detailed testing should be performed for the further testing of the code. 46 refs., 39 figs., 6 tabs.

51772 (PNL–6917) **Biodenitrification of Hanford groundwater and process effluents: FY 1988 status report.** Koegler, S.S.; Brouns, T.M.; Heath, W.O.; Hicks, R.J. Pacific Northwest Lab., Richland, WA (USA). Sep 1989. 47p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-76RL01830. Order Number DE90000993. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Laboratory screening tests were performed to select microorganisms for their ability to destroy nitrates and carbon tetrachloride in Hanford groundwaters. The microorganisms were subsequently tested in bench-scale experiments to determine the fundamental kinetic constants for denitrification with acetate. The microorganisms were also used as the inoculum for the pilot-scale bioreactor system, which was designed, constructed, and operated in FY 1988. The bench-scale denitrification kinetic data were analyzed using two rate models. The best fit was obtained using a first-order expression. The kinetic constants determined in the bench-scale experiments were later used to set operating parameters for the pilot-scale bioreactor test. The pilot-scale bioreactor system consisted of a 50-L continuous-stirred tank bioreactor, a 280-L clarifier, associated feed components, and a data acquisition and control system. The pilot plant was designed as a module for ease of installation and to facilitate relocation for on-site demonstration testing. The pilot-scale bioreactor was installed and operated in FY 1988, but steady-state operating data are not yet available. Preliminary denitrification data show destruction of nitrate to concentrations less than drinking water standards. A preliminary engineering evaluation was also completed in FY 1988 that examined the engineering feasibility of biodenitrification for the UO_3 Plant process condensate through microorganism laboratory testing, development of flowsheets, and equipment size and cost estimates. 15 refs., 16 figs., 8 tabs.

51773 (PNL–6967) **Product consistency test round robin conducted by the Materials Characterization Center: Summary report.** Piepel, G.F.; Jones, T.E.; Eggett, D.L.; Mellinger, G.B. Pacific Northwest Lab., Richland, WA (USA). Sep 1989. 148p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC06-76RL01830. Order Number DE90000950. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

The Savannah River Laboratory (SRL) Product Consistency Test (PCT) was developed as a short duration leach test that could be

used to evaluate the consistency of Defense Waste Processing Facility (DWPF) glass. The goals were to develop a test that would be sensitive to glass composition and homogeneity, rapid enough to support quality control of the production process, and easily conducted remotely to facilitate working with highly radioactive materials. The long-term SRL goal is to show that the PCT can be used to demonstrate that DWPF glass meets the elemental and radionuclide release requirements of the Waste Acceptance Preliminary Specifications (WAPS). The Materials Characterization Center (MCC) at Pacific Northwest Laboratory (PNL) was requested by SRL to conduct a multi-laboratory round robin to evaluate the effectiveness of the PCT methodology. 12 figs., 10 tabs.

51774 (PNL-SA–16663) **Methodology for performance assessment of double-shell tank waste at Hanford.** McNair, G.W.; Mitchell, D.H.; Nelson, R.W.; Lamar, D.A. Pacific Northwest Lab., Richland, WA (USA). Sep 1989. 14p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-890928–7: Nuclear waste isolation in the unsaturated zone: FOCUS '89, Las Vegas, NV (USA), 18-21 Sep 1989). Order Number DE90001395. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The low-level liquid waste stored in double-shell tanks at Hanford will be solidified in a cementitious matrix (grout) and disposed in subsurface vaults. This paper discusses activities related to the preparation of a site-specific performance assessment as required by DOE Order 5820.2A. A performance assessment is being prepared for the planned grout disposal system at Hanford using site-specific data. The assessment will estimate the incremental increase in the radiological dose to future populations who, after loss of institutional control at the site, use groundwater downgradient of the disposal site. Increases in nonradiological species in water from a hypothetical well will also be estimated. Two-dimensional transport models are being used to estimate contaminant concentrations in groundwater. Sensitivity studies on various parameters are in progress. This performance assessment will be updated as additional data become available. 16 refs., 1 fig., 2 tabs.

51775 (RFP–4344) **Compatibility coding of liquid hazardous waste.** Compton, G.G. Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant. [1989]. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP03533. (CONF-891042–1: 31. ORNL/DOE conference on analytical chemistry in energy technology; 3. annual Colorado Hazardous Waste Management Society conference, Gatlinburg, TN (USA); , CO (USA), 10-12 Oct 1989; 6-7 nov 1989; CONF-891193–1). Order Number DE89017713. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The determination of the chemical compatibility of hazardous waste is necessary to facilitate safe shipping, storage or treatment of the waste. This paper discusses methods involving physical and chemical characterization. Generator information is used as a guide during the characterization process. The analyses that are performed are simple, qualitative tests. These provide the analyst with the necessary information to assign a compatibility code to the sample within 24 hours of sample collection. 1 fig.

51776 (SAND–89-1257) **Issues pertinent to sealing of radioactive waste repositories in bedded salt formations.** Nowak, E.J. Sandia National Labs., Albuquerque, NM (USA). Aug 1989. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8905136–1: Joint NEA/CEC workshop on sealing of radioactive waste repositories, Braunschweig (Germany, F.R.), 22-25 May 1989). Order Number DE90000893. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Issues that have been identified as pertinent to sealing of radioactive waste repositories in bedded salt formations include: overall seal system functions and strategy for waste isolation; performance requirements for the seal system; the need for redundancy; locations of long-term seals in excavations and boreholes; requirements for sealing interbeds and the disturbed rock zone (DRZ) seal stability for the required lifetime; and the need for short-term seals in addition to long-term seals. These issues are defined in general terms, and some principles that may be useful in addressing them are presented. Although this presentation was derived from experience with bedded salt, it has applicability to domal salt as well.

51777 (SAND–89-1915C) **A sensitivity analysis of flow through layered, fractured tuff: Implications for performance allocation and performance assessment modeling.** Prindle, R.W. Sandia National Labs., Albuquerque, NM (USA). [1989]. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC04-76DP00789. (CONF-890928–5: Nuclear waste isolation in the unsaturated zone: FOCUS '89, Las Vegas, NV (USA), 18-21 Sep 1989). Order Number DE90001172. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We have recently completed a sensitivity study of unsaturated flow through a system of layered, fractured tuffs. This study was defined and performed for the International Hydrologic Code Intercomparison Project (HYDROCOIN). The modeled system was highly constrained and simplified but was loosely based on conditions though to exist at Yucca Mountain. The proposed paper will cover: a brief description of the system modeled, the mathematical model used, and the analyses performed for this study; a summary of the major conclusions drawn regarding the important types of flow behavior that were observed, and a discussion of the implications of the different types of flow behavior for performance allocation and for performance assessment using simplified models.

51778 (SAND–89-2135C) **A description and status of the Yucca Mountain Project repository sealing program.** Fernandez, J.A.; Hinkebein, T.E. Sandia National Labs., Albuquerque, NM (USA). [1989]. 7p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC04-76DP00789. (CONF-8904272–1: International high-level radioactive waste management conference, Las Vegas, NV (USA), 18-21 Apr 1989). Order Number DE90000665. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Yucca Mountain is being characterized to determine its suitability as a site for a high-level nuclear waste repository. The repository would be located in the unsaturated zone in fractured, welded tuff. Sealing of the repository is one element of the Yucca Mountain Project (YMP). This paper presents a description of the repository sealing program including the sealing design options, design requirements, design constraints, and the identification of the proposed sealing materials and field tests. Design options for the shafts include anchor-to-bedrock seals, shaft fill, and settlement plugs; in the underground facility options include drift seals, drainage channels, sumps, and bulkheads. Design requirements are those quantitative requirements imposed on the sealing design options to achieve a desired level of performance. Constraints are restrictions placed on the repository design by the sealing design. As (1) additional hydrogeologic data are obtained through site characterization, (2) approaches to allocating performance to various subsystems within the YMP are refined, and (3) the exploratory shafts and the associated testing results are developed, the design requirements and constraints may be modified and used in developing the License Application Design. 1 ref., 1 fig.

51779 (UCID–21811) **Verification of the NIKE3D structural analysis code by comparison against the analytic solution for a spherical cavity under a far-field uniaxial stress.** Kansa, E.J. Lawrence Livermore National Lab., CA (USA). Jan 1989. 116p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-7405-ENG-48. Order Number DE90000929. Available from NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.

The original scope of this task was to simulate the stresses and displacements of a hard rock tunnel experimental design using a suitable three-dimensional finite element code. NIKE3D was selected as a suitable code for performing these primarily approximate linearly elastic 3D analyses, but it required modifications to include initial stress, shear traction boundary condition and excavation options. During the summer of 1988, such capabilities were installed in a special version of NIKE3D. Subsequently, we verified both the LLNL's commonly used version of NIKE3D and our private modified version against the analytic solution for a spherical cavity in an elastic material deforming under a far-field uniaxial stress. We find the results produced by the unmodified and modified versions of NIKE3D to be in good agreement with the analytic solutions, except near the cavity, where the errors in the stress field are large. As can be expected from a code based on a displacement finite element formulation, the displacements are much more accurate than

the stresses calculated from the 8-noded brick elements. To reduce these errors to acceptable levels, the grid must be refined further near the cavity wall. The level of grid refinement required to simulate accurately tunneling problems that do not have spatial symmetry in three dimensions using the current NIKE3D code is likely to exceed the memory capacity of the largest CRAY 1 computers at LLNL. 8 refs., 121 figs.

51780 (WHC-EP–0182-16) **Tank farm surveillance and waste status summary report for July 1989.** Thurman, J.M. Westinghouse Hanford Co., Richland, WA (USA). Sep 1989. 38p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. Order Number DE90001135. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report is Westinghouse Hanford Company's official inventory for high-level radioactive waste stored in underground tanks at the Hanford Site. Data that depict the status of stored, high-level waste and tank vessel integrity are contained within the report. The intent of the report is to provide data on each of the existing 177 underground waste tanks, as well as to provide supplemental information regarding tank anomalies and ongoing investigations.

51781 (WHC-EP–0231-2) **Hanford Surplus Facilities Program plan: Fiscal year 1990.** Hughes, M.C.; Wahlen, R.K.; Winship, R.A. Westinghouse Hanford Co., Richland, WA (USA). Sep 1989. 100p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. Order Number DE90000933. Available from NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.

The Hanford Surplus Facilities Program is responsible for the safe and cost-effective surveillance, maintenance, and decommissioning of surplus facilities at the Hanford Site. The management of these facilities requires a surveillance and maintenance program to keep them in a safe condition and development of a plan for ultimate disposition. Criteria used to evaluate each factor relative to decommissioning are based on the guidelines presented by the US Department of Energy-Richland Operations Office, Defense Facilities Decommissioning Program Office, and are consistent with the Westinghouse Hanford Company commitment to decommission the Hanford Site retired facilities in the safest and most cost-effective way achievable. This document outlines the plan for managing these facilities to the end of disposition.

51782 (WHC-EP–0275-Rev.1) **Draft liquid effluent study project plan: Revision 1.** Westinghouse Hanford Co., Richland, WA (USA). Sep 1989. 33p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. Order Number DE90001239. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In response to public comments received on the Hanford Federal Facility Agreement and Consent Order (Agreement), and at the request of the Washington Department of Ecology (Ecology) and the US Environmental Protection Agency (EPA), the US Department of Energy (DOE) is undertaking a study to provide a detailed discharge history, and radiological and chemical characteristics of liquid discharges to the soil column at the Hanford Site per the letter written from DOE to Ecology and EPA. 17 refs., 3 figs., 3 tabs.

51783 (WHC-SA–0142) **Application and results of a reinjection technique for hydrothermal experiments in Dickson autoclaves.** Hoover, J..D; Gardiner, M.A.; Kacandes, G.H.; Ulmer, G.C.; Grandstaff, D.E. Westinghouse Hanford Co., Richland, WA (USA). Nov 1987. 11p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC06-87RL10930. (CONF-871124–107: Fall meeting of the Materials Research Society, Boston, MA (USA), 30 Nov - 5 dec 1987). Order Number DE90001217. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Cohassett basalt was reacted with synthetic Hanford groundwater in a Dickson rocking autoclave at 300°C and 30 MPa for *ca.* 7600 hours. During the experiment fresh solution was twice reinjected into the reaction cell, raising the nominal water:rock mass ratio from 50:1 to 140:1. The reinjection experiment is intermediate between closed-system Dickson experiments and flow-through tests in that the fluid and solids can remain in contact for extended periods of time before the solution is replaced. This allows more time for equilibrium to be approached. Data from this experiment suggest: (1) After reinjection many solution parameters quickly (hrs-days) returned to near preinjection values. (2) The redox buffer capacity of the basalt was not exceeded, i.e. fO_2 values remained near magnetite-hematite values, although the nominal water:rock mass ratio was raised to *ca.* 140 during the experiment. (3) After reinjection the stable high-temperature pH value was only slightly less than the initial pH value. (4) The silica concentration stabilized near apparent quartz saturation rather than the cristobalite saturation value found in close-system experiments. (5) Short-term relationships between cations appear to be controlled by ion-exchange between the solutions and clay minerals. 27 refs., 7 figs.

51784 (WSRC-RP–89-457) **Large scale process simulation: A case study integrated waste processing flowsheet for SRS [Savannah River Site].** Fowler, J.R.; Edwards, R.E. Jr. Westinghouse Savannah River Co., Aiken, SC (USA). [1989]. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-891192–5: Annual Westinghouse computer symposium, Pittsburgh, PA (USA), 6-7 Nov 1989). Order Number DE89017865. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A chemical process flowsheet model is described. This computer model consists of 161 components per stream, over 1000 streams, more than 400 unit operation blocks, more than 200 chemical reactions, eight recycle loops, 34 user-added subroutines, and three separate physical property sets. We discuss why such models are necessary, how to build them, and how to use them. This model simulates processing of defense waste at the Savannah River Site (SRS). It has played a vital role in the design, construction, and permit applications for the Defense Waste Processing Facility (DWPF) and ancillary facilities that are being built at the SRS at a cost of about $1 billion. Waste processing at SRS will incorporate radioactive components into glass wasteforms suitable for long-term geological disposal. Using an integrated approach, the various processes to be used at SRS are combined into a single model to help assure that changes in one process will not adversely affect other processes. Separate modules were developed for the model to simulate salt decontamination, in-tank sludge processing, decontaminated salt processing, preparation of melter feed, vitrification, offgas processing, byproducts processing, and wastestream treatment. 4 refs., 1 fig.

51785 (WSRC-RP–89-468) **Data acquisition system for monitoring nuclear waste vitrification.** Hunter, R.T. Westinghouse Savannah River Co., Aiken, SC (USA). [1989]. 19p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-891192–17: Annual Westinghouse computer symposium, Pittsburgh, PA (USA), 6-7 Nov 1989). Order Number DE90001373. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Implementation of a real time data acquisition system for monitoring certain parameters while processing simulated nuclear waste into borosilicate glass has been demonstrated in an experimental study conducted at the Savannah River Site (SRS). The experimental study's purpose is to investigate the effects of noble metal on joule heated ceramic melters. The data acquisition system was designed to monitor parameters were plotted to the computer screen during glass melting so that any change in the behavior of the melter could be easily detected. Aside from the graphs, each parameter was given a maximum and minimum value that it could attain before the computer sounded an alarm. The data generated was stored on a hard disk for further analysis and interpretation. 5 refs., 12 figs., 1 tab.

51786 (WSRC-RP–89-660) **Defense Waste Processing Facility software implementation.** Reynolds, T.R. Westinghouse Savannah River Co., Aiken, SC (USA). [1989]. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-891192–10: Annual Westinghouse computer symposium, Pittsburgh, PA (USA), 6-7 Nov 1989). Order Number DE89017872. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Defense Waste Processing Facility (DWPF) at the Savannah River Site in Aiken, South Carolina will soon be the nation's first high-level radioactive waste glassification plant. The DWPF process will turn high-level, radioactive waste into molten glass that will be poured into stainless steel canisters for permanent storage in an offsite geologic repository. The DWPF process will be operated by a

microprocessor-based Distributed Control System. At startup, approximately 120,000 lines of application code will be in place to monitor and control the vitrification process. 1 ref., 7 figs.

51787 (WSRC-RP–89-782) **Vitrification at the Savannah River Site.** Carlson, M.K. Westinghouse Savannah River Co., Aiken, SC (USA). [1989]. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-8909110–6: 16. annual conference of the American Society for Quality Control, Fort Lauderdale, FL (USA), 17-20 Sep 1989). Order Number DE90001993. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Construction of the Defense Waste Processing Facility (DWPF) at the Savannah River Site is nearing completion, and preparations are being made to start nonradioactive cold runs. Because quality assurance requirements for the DWPF are similar to those for the Hanford Waste Vitrification Project, this presentation describes: the need for the facility, the chemical processes involved in preparation of waste for vitrification, handling and preparing the product for storage, and the unique equipment developed for remote operation and maintenance.

51788 **Inhibition of nuclear waste solutions containing multiple aggressive anions.** Congdon, J.W. 7p. National Assoc. of Corrosion Engineers, Houston, TX (1988). (CONF-880314–: Corrosion '88: National Association of Corrosion Engineers meeting, St. Louis, MO (USA), 21-25 Mar 1988).

Technical Paper 88274.

The inhibition of localized corrosion of carbon steel in caustic, high-level radioactive waste solutions was studied using cyclic potentiodynamic polarization scans, supplemented by partially immersed coupon tests. The electrochemical tests provided a rapid and accurate means of determining the relationship between the minimum inhibitor requirements and the concentration of the aggressive anions in this system. Nitrate, sulfate, chloride, and fluoride were identified as aggressive anions, however, no synergistic effects were observed between these anions. This observation may have important theoretical implications because it tends to contradict the behavior of aggressive anions as predicted by existing theories for localized corrosion.

51789 **Statement of John H. Anttonen, Project Manager, Basalt Waste Isolation Project, Richland Operations Office, Department of Energy.** pp. 683 of Nuclear waste program. Hearing before the Committee on Energy and Natural Resources, United States Senate, One Hundredth Congress, First Session, June 29, 1987, Part 4. Government Printing Office, Washington, DC (US) (1987).

My name is John Anttonen and I am the Project Manager for the Basalt Waste Isolation Project (BWIP) at the Department of Energy Richland Operation Office. The responsibilities of may office are to manage the day-to-day activities of the site suitability investigations of the basalt formations at the Hanford Site, a Department complex that is involved in a variety of national missions, including defense materials production, nuclear energy research, and radioactive waste management. In may prepared comments today I would like to touch upon four specific subject areas relating to the BWIP program and then I would be happy to answer any questions you might have. The topics I will cover are: (1) historical aspects; (2) site specific technical issues and how they will be addressed during site characterization of the basalt site at Hanford; (3) current project status and; (4) institutional interaction. For clarity, I have attached several charts to my statement.

51790 **Statement of Hugh L. Thompson, Jr. Director, Office of Nuclear Material Safety and Safeguards, US Nuclear Regulatory Commission, accompanied by Robert E. Browning, Director, Division of High Level Waste Management; and Richard E. Cunningham, Director, Division of Fuel Cycle, Medical, Academic, and Commercial Use Safety.** pp. 583 of Nuclear waste program. Hearings before the Committee on Energy and Natural Resources, United States Senate, One Hundredth Congress, First Session, April 28 and 29, 1887, Part 2. Government Printing Office, Washington, DC (US) (1987).

The author would like to thank you this morning, Mr. Chairman, for the opportunity to provide the NRC staff views on several matters related to the Department of Energy's civilian high level radioactive waste program that are of interest to you and other members of the committee. As requested in your letter in invitation, I will first discuss NRC staff comments on DOE's final environmental assessments. The NRC comments on DOE's environmental assessments were also the subject of your letter of March 10th, 1987, to the Commission; and the Commission's April 13th, 1987 reply. With your permission, Mr. Chairman, I would like to introduce these letters into the record.

51791 **Statement of Dr. Frank L. Parker, Chairman, Board on Radioactive Waste Management, National Academy of Sciences, accompanied by Dr. Peter B. Myers, Staff Director.** pp. 583 of Nuclear waste program. Hearings before the Committee on Energy and Natural Resources, United States Senate, One Hundredth Congress, First Session, April 28 and 29, 1887, Part 2. Government Printing Office, Washington, DC (US) (1987).

The author is pleased to be here to explain the role of the Board of Radioactive Waste Management in the review of Department of Energy's work. The Board does not set up projects on its own; it can only recommend projects to the Commission of the National Research Council, in addition to which we do not choose the members of the panel, we can only recommend members of the board or panels which work under the board to that commission. At the present time the board has active panels looking at the waste isolation pilot plant for transuranic waste in Carlsbad, New Mexico, and at the disposition of the waste within the single shell tanks at the Hanford reservation. The Board expects its panels to follow procedures similar to those of the WIPP oversight panel and the oversight of the three proposed sites for characterization. At present, the proposal for the establishment of the three panels is in the Research Council's internal approval cycle. When approved, it will be delivered to the Department of Energy, and further progress then will be coupled to their procurement process.

51792 **Statement of J.D. Neff, Manager, Salt Repository Project Office, Department of Energy.** pp. 683 of Nuclear waste program. Hearing before the Committee on Energy and Natural Resources, United States Senate, One Hundredth Congress, First Session, June 29, 1987, Part 4. Government Printing Office, Washington, DC (US) (1987).

My name is Jeff Neff and I am the Manager of the US Department of Energy's Salt Repository Project Office, now located in Hereford, Texas. The responsibilities of my office are to manage the day-today activities of the site suitability investigations of the designated nine-square-mile site located in Deaf Smith County, near Hereford in the Texas Panhandle. The location is indicated on several of the attachments. My remarks will be divided into five categories: (1) a brief history of how the Deaf Smith County site was designated; (2) a review of major issues for the Texas site and how these are expected to be resolved during site characterization; (3) a summary of major institutional issues; (4) a summary of consultation and cooperation activities with the State of Texas, through its Nuclear Waste Programs Office; and (5) highlights of current and past interactions with local governmental officials and the public in the Panhandle.

51793 **Statement of Ben C. Rusche, Director, Office of Civilian Radioactive Waste Management, Department of Energy.** pp. 583 of Nuclear waste program. Hearings before the Committee on Energy and Natural Resources, United States Senate, One Hundredth Congress, First Session, April 28 and 29, 1887, Part 2. Government Printing Office, Washington, DC (US) (1987).

The author appreciate the opportunity to appear before you today to discuss activities related to site characterization of candidate sites for the Nation's first geologic repository for spent nuclear fuel and high-level radioactive waste. As you requested in your letter of invitation, I will focus my testimony on site characterization plans, the strategy for resolving technical issues raised by the Nuclear Regulatory Commission (NRC) during site characterization, plans for interacting with the National Academy of Sciences during site characterization and our strategy for assuring technical excellence through each step.

51794 **Overview and current status of the US radioactive-waste management program.** Rousso, S. *Transactions of the*

American Nuclear Society (USA), 58: 88-90 (1989). (CONF-8810179–: International conference on nuclear fission: fifty years of progress in energy security, Washington, DC (USA), 30 Oct - 4 nov 1988).

The Office of Civilian Radioactive Waste Management was reorganized along functional lines, a request was issued for proposals for a management and operating contractor, a strategy and plan was developed for implementing the new statutory requirements, systems for schedule and cost control were refined, and all activities in information-resource management were consolidated. A significant effort was directed at reinforcing the managing-for-quality concept throughout the program. A monumental effort has been required to develop the consultation draft of the site-characterization plan (SCP) for Yucca Mountain, engage in intensive interactions with the NRC on this plan, revise the plan, and work on the associated study plans. The most important achievement has probably been a thorough revamping of our program for quality assurance. Joint projects with other countries are being conducted on the validation of performance-assessment codes and the evaluation of experimental methods. US DOE is cooperating with other nations by providing technical assistance in the field of spent-fuel storage and disposal. The purpose of all this activity is to develop the authorized waste-management system in a technically sound manner, as cost-effectively as possible, and at the earliest possible time. This system consists of three elements: the MRS facility, the repository, and the transportation system. The focus of the program remains permanent disposal in a geologic repository, and the functions of the other components of the waste-management system will be integrated to support the repository.

51795 Repository programs in Europe. Garcia, A.L. *Transactions of the American Nuclear Society (USA),* 58: 94-101 (1989). (CONF-8810179–: International conference on nuclear fission: fifty years of progress in energy security, Washington, DC (USA), 30 Oct - 4 nov 1988).

The major part of this paper deals with the deep geological disposal of high-level waste (HLW). The final disposal of this type of waste in deep and stable geological formations is, at the present time, generally accepted as safe and as the most practicable option. The safe disposal in deep geological formations requires essentially the understanding of the short- and long-term behaviors of the waste forms to be disposed of and their most adequate containment systems, as well as of the characteristics and expected behavior of the disposal system during its construction and operation, and subsequently of the surrounding host rock during several tens of thousands of years. The development of this technological area in the European countries has followed a process which can be generally defined by the following four consecutive large phases; identification of favorable geological formations; technical developments in geological media; site selection process and characterization of the chosen site; and construction and startup. Radioactive waste management is similarly organized in all western European countries. The available level of knowledge on the disposal of HLW has make possible the setting up of clear and realistic national repository programs.

51796 Below-regulatory-concern rulemaking in Texas: Disposal of short-lived wastes in municipal landfills. Pollard, C.G.; McBurney, R.E.; Bryant, H.W. *Transactions of the American Nuclear Society (USA),* 56: 60 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

In June 1986, the Texas Low-Level Radioactive Waste Disposal Authority, with Rogers and Associates Engineering Corporation, completed a technical report analyzing the impact to Texas of disposing radioactive wastes containing low concentrations of short-lived radionuclides in permitted municipal landfills. The report establishes concentration and annual curie limits for radionuclides with half-lives <300 days such that no individual would receive a dose >1 mrem/yr. This method of disposal would result in a 50% reduction in the Texas institutional low-level waste volume and save waste generators $600,000 a year in disposal costs. In July 1986, the authority requested the Texas Department of Health to develop a rule to allow the municipal landfill disposal of short-lived wastes below the concentration and annual curie limits established in the technical report. The technical report was the support document for the request. Staff of the Bureau of Radiation Control, Texas Department of Health, reviewed the request for a rule change in August 1986 and revised the draft rule in response to regulatory concerns. The rule change was formally proposed on January 2, 1987, and will be a final rule in May 1987.

51797 Waste isolation pilot plant: Program status. Hunt, A.E. *Transactions of the American Nuclear Society (USA),* 56: 62-63 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The Waste Isolation Pilot Plant (WIPP) is dedicated to demonstrating the safe disposal of defense-generated radioactive wastes. Public Law 96-164 defines the WIPP mission specifically as ... a defense activity ... for the express purpose of providing a research and development facility to demonstrate the safe disposal of radioactive wastes resulting from the defense activities and programs of the United States exempted from regulation by the Nuclear Regulatory Commission. The WIPP will retrievably store transuranic (TRU) waste that has been accumulating in temporary government storage facilities across the nation since 1970. The WIPP, located in Eddy County ≈41 km east of Carlsbad, New Mexico, is situated amidst the Permian Salt Basin, a 915-m-thick salt formation deposited between 220 and 250 million yr ago. The excavated storage horizon is 655.3 m below the earth's surface, approximately in the center of this formation. The functional aspects of WIPP may be subdivided into six basic sections: (1) project management, (2) construction, (3) institutional programs, (4) technology development, (5) plant operations and (6) waste transportation. This paper discusses the current status, recent advances, and planned future accomplishments of each of these six subdivisions, as well as the working relationship of these units as a whole with regard to meeting WIPP's mission on schedule, within budget, and in conformance with applicable technical and institutional baselines.

51798 Start-up planning at the waste isolation pilot plant. Hunter, E.K. *Transactions of the American Nuclear Society (USA),* 56: 63 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The Waste Isolation Pilot Plant (WIPP) will begin functioning as an operating nuclear waste storage facility when initial shipments of transuranic waste to the WIPP begin in October 1988. Before the WIPP can enter its 1988-1993 operations demonstration phase, however, a record of decision by the US Department of Energy's (DOE's) Energy System Acquisition Advisory Board (ESAAB) must be issued with a recommendation to proceed with the WIPP transition to an operations phase. Start-up planning involves (a) the identification of those activities that must be accomplished prior to beginning operations, (b) establishment of a scheduling/management system for tracking such activities, (c) development of a coordination process to ensure all participating organizations are appropriately involved in areas of responsibility as set forth in items a and b, and (d) development of a verification and documentation process for presentation to the ESAAB.

51799 Use of performance assessments to generate a repository Q list. Jardine, L.J.; Laub, T.W. *Transactions of the American Nuclear Society (USA),* 56: 65-67 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Items identified and classified as important to safety are placed on the repository Q list. The Q list identifies structures, systems, and components that are subject to quality assurance (QA) requirements beyond standard engineering practices as specified by 10CFR60, Part G. These QA requirements correspond to those imposed by 10CFR50, Appendix B, for safety class systems in nuclear power plants. These QA measures are applied to the repository design, procurement, and construction activities and operations to provide a higher degree of assurance that Q-list items will perform their intended functions. The QA measures are implemented by the direct incorporation of the requirements into appropriate design documents, such as drawings, specifications, and operational procedures. An assessment to identify items important to safety was completed for the proposed Yucca Mountain repository. The assessment implemented a classification methodology based on general guidance developed by the U.S. Department of Energy (DOE) for use by all repository projects. Although some qualitative

judgment techniques were used, the assessment was based on quantitative dose and frequency performance assessments. This paper discusses the results of applying a performance assessment to generate the initial Yucca Mountain repository Q list.

51800 In situ vitrification of mixed wastes. Timmerman, C.L. *Transactions of the American Nuclear Society (USA),* 56: 58 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

As management of hazardous materials gains increased attention in the United States, new and more effective technologies are being sought to immobilize and/or destroy the wastes, either in situ for previously disposed wastes or at the waste generation site. Pacific Northwest Laboratory (PNL) is developing a remedial action process for contaminated solid that is potentially significant in its application to these concerns. The process was initially developed to demonstrate a potential technology for disposal of transuranic-waste-contaminated soil sites; however, recent tests have shown that many hazardous chemical wastes are also destroyed or immobilized as a result of the treatment. The process, in situ vitrification (ISV), was originally developed for the US Department of Energy (DOE) and is more recently being adapted for selected commercial clients for hazardous wastes. In situ vitrification is a thermal treatment process that converts contaminated soil into a chemically inert, stable glass and crystalline product.

51801 US ecology's efforts to obtain permission for mixed-waste disposal. Scoville, J.J. *Transactions of the American Nuclear Society (USA),* 56: 59-60 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

With the passage of the Resource Conservation and Recovery Act (RCRA) in 1980, US Ecology became a leader in attempting to interpret and analyze the overlap in authority and conflicts in regulation between the US Environmental Protection Agency (EPA) and the US Nuclear Regulatory Commission (NRC) and their respective parallels at the state level. A careful reading of the language of RCRA caused the company to adopt a prudent position of filing an RCRA Part A application for each of its two low-level radioactive waste (LLRW) facilities at Beatty, Nevada, and Richland, Washington. Coincident with the filings, the company asked for clarification regarding the applicability of RCRA to LLRW facilities that were already under stringent federal and state regulations. A chronological account of attempts to resolve the conflicts and a status of negotiating efforts are presented in the paper.

51802 Management of below-regulatory-concern wastes at Duke Power Company. Schulte, J.H.; Birch, M.L. *Transactions of the American Nuclear Society (USA),* 56: 60-61 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Since the late 1970s, escalating disposal charges and the uncertain regulatory and political climate have encouraged Duke Power to reduce radwaste volumes. Volume reduction is a philosophy that must be a fundamental part of an organization's priorities and must be incorporated in all aspects of nuclear station operation, maintenance, and management. In the same way that safety is a major part of nuclear station design and operation, volume reduction is incorporated in station directives, personnel training, organizational emphasis, procedures, process equipment selection, and operating methods. Volume reduction techniques have been chosen based on studies of each waste source. Several volume reduction techniques are applied to each waste stream. The most effective volume reduction technique is to eliminate or minimize waste at the source. There are two programs that accomplish waste minimization at the source: source control and below regulatory concern (BRC) disposal (alternative disposal). These programs are based on the premise that the most effective volume reduction technique is to eliminate or minimize waste at the source. Both programs have saved burial space and reduced our waste disposal costs.

51803 Status of mixed-waste regulation. Bahadur, S. *Transactions of the American Nuclear Society (USA),* 56: 61 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Mixed waste is waste containing radionuclides regulated by the US Nuclear Regulatory Commission (NRC) under the Atomic Energy Act, as well as hazardous waste materials regulated by the Environmental Protection Agency (EPA) under the Resource Conservation and Recovery Act (RCRA). This has led to a situation of dual regulation in which both NRC and EPA regulate the same waste under requirements that at times appear conflicting. The NRC has been working with the EPA to resolve the issues associated with the dual regulation of mixed waste. Discussions between the two agencies indicate that dual regulation of mixed wastes appears technically achievable, although the procedures may be complex and burdensome to the regulated community. The staffs of both agencies have been coordinating their efforts to minimize the burden of dual regulation on state agencies and the industry. Three major issues were identified as sources of potential regulatory conflict: (a) definition and identification of mixed waste, (b) siting guidelines for disposal facilities, and (c) design concepts for disposal units.

51804 Human engineering considerations in the design of major radwaste systems. Doyle, R.D; Low, R.L. *Transactions of the American Nuclear Society (USA),* 56: 84-85 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

For today's nuclear industry, three types of radwaste process systems are being supplied: (1) permanent systems in new plants or new radwaste facilities at currently operating plants, (2) retrofit permanent systems into existing and operating plant facilities, and (3) temporary systems usually provided on a service basis to meet short-term needs. For each of these three types of systems, the designer reaches a point where a trade-off has to be made (i.e., in a retrofit, whether to remove and relocate a shield wall or put up with the inefficient use of space). When human engineering is considered, however, the process of trade-offs can be evaluated in a systematic and logical manner. Using human engineering considerations also provides the ultimate user, the operations and maintenance group, with a system that meets safety and as-low-as-reasonably-achievable (ALARA) concepts. This paper provides insight into these considerations and the ramifications on a given installation as well as brief summary of the ramifications for each type of facility.

51805 Overview of the US program for developing a waste disposal system for spent nuclear fuel and high-level waste. Kay, C.E. *Transactions of the American Nuclear Society (USA),* 56: 141 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Safe disposal of spent nuclear fuel and radioactive high-level waste (HLW) has been a matter of national concern ever since the first US civilian nuclear reactor began generating electricity in 1957. Based on current projections of commercial generating capacity, by the turn of the century, there will be >40,000 tonne of spent fuel in the Untied States. In addition to commercial spent fuel, defense HLW is generated in the United States and currently stored at three US Department of Energy (DOE) sites: The Nuclear Waste Policy Amendments Act of 1987 provided for financial incentives to host a repository or a monitored retrievable storage (MRS) facility; mandated the areas in which DOE's siting efforts should concentrate (Yucca Mountain, Nevada); required termination of site-specific activities at other sites; required a resisting process for an MRS facility, which DOE had proposed as an integral part of the waste disposal system; terminated all activities for identifying candidates for a second repository; established an 11-member Nuclear Waste Technical Review Board; established a three-member MRS commission to be appointed by heads of the US Senate and House; directed the President to appoint a negotiator to seek a state or Indian tribe willing to host a repository or MRS facility at a suitable site and to negotiate terms and conditions under which the state or tribe would be willing to host such a facility; and amended, adjusted, or established other requirements contained in the 1982 law.

51806 The DOE repository program. Isaacs, T. *Transactions of the American Nuclear Society (USA),* 56: 142 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The US Department of Energy (DOE) has been directed by the Congress in the Nuclear Waste Policy Amendments Act (NWPAA)

to characterize the Yucca Mountain, Nevada, site as the initial candidate site for the nation's first geologic repository. Site characterization through ongoing surface-based testing has been under way since the President approved the recommendation of the Yucca Mountain site as one of three candidate sites in May 1986. A more extensive site characterization program, including construction of exploratory shafts and an underground testing facility, has been described in the consultative draft site characterization plan (SCP-CD), which was provided to the state of Nevada and the U.S. Nuclear Regulatory Commission (NRC) in January 1988 for review and comment. In addition, technical workshops were held with the state of Nevada, the NRC, and their contractors in February and March to discuss specific technical issues in the SCP-CD.

51807 DOE's storage, transportation, and systems integration activities. Klein, K.A. *Transactions of the American Nuclear Society (USA),* 56: 143-144 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The current status of the following U.S. DOE programs are discussed: monitored retrievable storage activities, transportation activities, and systems integration. Also described are storage research, development, and demonstration activities with respect to dry storage modules and prototypical rod consolidation development.

51808 Tracer travel time and model validation. Tsang, C.F. (Lawrence Berkeley Lab., CA (USA)). *Transactions of the American Nuclear Society (USA),* 56: 157-158 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The performance assessment of a nuclear waste repository demands much more compared to the safety evaluation of civil constructions such as dams, or the resource evaluation of a petroleum or geothermal reservoir. It involves the estimation of the low probability (low concentration) of radionuclide transport extrapolated thousands of years into the future. Thus, models used to make these estimates need to be carefully validated. The present paper discusses some issues of validation regarding radionuclide transport. In model validation, it is important to consider the proper performance measures, so that we are not addressing a measure that is too difficult to predict and that is actually not required for the performance assessment. It turns out that point predictions are perhaps not necessary, but averaged line or areal predictions are more feasible and may be all that are needed. This conclusion, which is very tentative, may have significant impact on the design of experiments that will be used for model validation.

51809 The role of natural analogs in performance assessment. Kovach, L.A.; McCartin, T.J. *Transactions of the American Nuclear Society (USA),* 56: 158 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

A geologic repository is currently being designed to isolate the nations's high-level nuclear waste (HLW). The US Nuclear Regulatory Commission (NRC) regulation for HLW disposal (10CFR60) requires compliance with the overall Environmental Protection Agency (EPA) standard for waste isolation and places additional requirements on other components of the geologic repository. The demonstration of compliance with these regulations will require prediction of the system and subsystem performance for times up to 10,000 yr. The ability of system performance models to predict the behavior of the repositories over the spatial and temporal scales of interest can only be partially validated using short-term, laboratory scale models and field tests. The use of natural analogs has often been cited as a possible means of validation of repository system performance models. This idea has met with much opposition, generally from modelers and those experienced in validation of system performance models for complex engineered systems. It is concluded here that natural analog studies are useful to the performance assessment model validation process; however, caution must be taken in carefully identifying the questions, the appropriate natural system to answer those questions, and the type and amount of data to be collected in an attempt to both understand the natural system and validate the model. With careful planning of natural analog studies, the studies will be useful for quantitative as well as qualitative purposes.

51810 The INTRAVAL project: An international effort toward validation of geospheric transport models used in performance assessment. Andersson, K.; Larsson, A.; Grundfelt, B. *Transactions of the American Nuclear Society (USA),* 56: 159-160 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The safety assessment of a proposed repository for radioactive waste involves predictions of the long-term behavior of the repository system using quantitative modeling of natural and engineered subsystems. Considering that nuclear waste disposal programs gradually leave a generic stage and enter a stage of application, it is clear that the need for validated models will increase. There seems to be general consensus that future performance assessment model systems should be more firmly based on experimental and natural evidence than current model systems. In October 1987, the international INTRAVAL project was started in Stockholm as an international effort toward validation of geosphere models. The project has been initiated by the Swedish Nuclear Power Inspectorate (SKI) and was prepared by an ad hoc group with representatives from eight national and international organizations. The purpose of the project is to increase the understanding of how various processes and geohydrological structures of importance for the transport of radionuclides from a repository to the biosphere can be properly described by mathematical models and how models developed for this purpose can adequately simulate the nuclide transport during short as well as very long time periods.

51811 International Alligator Rivers Analog Project. Bichard, G.F. *Transactions of the American Nuclear Society (USA),* 56: 160-161 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The Australian Nuclear Science and Technology Organization (ANSTO), the Japan Atomic Energy Research Institute, the Swedish Nuclear Power Inspectorate, the U.K. Department of the Environment, the US Nuclear Regulatory Commission (NRC), and the Power Reactor and Nuclear Fuel Development Corporation of Japan are participating under the aegis of the Nuclear Energy Agency in the International Alligator Rivers Analog Project. The project has a duration of 3 yr, starting in 1988. The project has grown out of a research program on uranium ore bodies as analogs of high-level waste (HLW) repositories undertaken by ANSTO supported by the NRC. A primary objective of the project is to develop an approach to radionuclide transport model validation that may be used by the participants to support assessments of the safety of radioactive waste repositories. The approach involves integrating mathematical and physical modeling with hydrological and geochemical field and laboratory investigations of the analog site. The Koongarra uranium ore body has been chosen as the analog site because it has a secondary ore body that has formed over the past million years as a result of leaching by groundwater flowing through fractures in the primary ore body.

51812 Uranium deposits in sandstones as analogs for spent fuel rod disposal. Brookins, D.G. (Univ. of New Mexico, Albuquerque (USA)). *Transactions of the American Nuclear Society (USA),* 56: 161-162 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Uranium deposits in sandstones are well suited as analogs for spent fuel rod disposal. These deposits typically occur as tabular or lensoid masses of uranium minerals impregnating sandstone, commonly where the argillaceous component of the rocks increases. Collectively, the geologic and geochemical evidence indicate that argillaceous sandstones mineralized with uranium would, under chemically reducing and even mildly oxidizing conditions, present a number of redundant barriers to migration of fission products and actinides from hypothetically branched spent fuel rods. Further, use of argillaceous sandstones either as a direct barrier (host rock or engineered backfill) or indirect barrier (i.e., layers of such rock above repository horizons) is considered reasonable based on the study of sandstone uranium deposits.

51813 Transient diffusion from a waste solid into fractured porous rock. Ahn, J. (Lawrence Berkely Lab., CA (USA)); Chambre, P.L.; Pigford, T.H. *Transactions of the American Nuclear Society (USA)*, 56: 173-174 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Previous analytical studies of the advective transport of dissolved contaminants through fractured rock have emphasized the effect of molecular diffusion in the rock matrix in affecting the space-time-dependent concentration of the contaminant as it moves along the fracture. Matrix diffusion only in the direction normal to the fracture surface was assumed. Contaminant sources were constant-concentration surfaces of width equal to the fracture aperture and of finite or infinite extent in the transverse direction. Such studies illustrate the far-field transport features of fractured media. To predict the time-dependent mass transfer from a long waste cylinder surrounded by porous rock and intersected by a fracture, the present study includes diffusion from the waste surface directly into porous rock, as well as the more realistic geometry. Here the authors present numerical results from Chambre's analytical solution for the time-dependent mass transfer from the cylinder for the low-flow conditions wherein near-field mass transfer is expected to be controlled by molecular diffusion.

51814 Systems approach to developing and implementing an HLW licensing process. Adler, R.; Patrick, W.; Whiting, A. *Transactions of the American Nuclear Society (USA)*, 56: 174-175 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Developing and licensing a repository for the disposal of high-level nuclear waste (HLW) is an important national goal. Congress reaffirmed this goal by the passage of the Nuclear Waste Policy Amendments Act (NWPAA) in December 1987. In addition to designating Yucca Mountain in Nevada as the sole site to undergo characterization, it authorized a monitored retrievable storage facility (MRS) and created a negotiator, a technical review board, and other entities whose efforts are directed to provide greater certainty in the nation's ability to manage its HLW. Responsibility for the formal licensing process for the life of the repository is assigned by law to the US Nuclear Regulatory Commission (NRC). In October of 1987, the NRC established the Center for Nuclear Waste Regulatory Analysis as a federally funded research and development center to assist in fulfilling its licensing mission with regard to HLW. The broad objective of the center is to assist the NRC in identifying and recommending solutions for technical, regulatory, and institutional uncertainties to ensure timely and credible completion of the licensing process. To meet this objective, the center is currently developing a systems approach to implement and streamline the HLW licensing process. This paper describes the basic systems approach and the design process and provides a status on the initial efforts of the center to develop this system.

51815 Waste package and underground facility design. Frei, M.W.; Dayem, N.J. *Transactions of the American Nuclear Society (USA)*, 56: 180 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The design of the waste package and the underground facility for radioactive waste disposal presents many challenges never before addressed in an engineering design effort. The designs must allow for handling and emplacement of the waste and must ensure that the waste will be isolated over time periods that extend beyond those normally dealt with in engineering solutions. Once developed, these designs must be defended in a licensing arena to allow construction and operation of the disposal system. The design of the waste package and the repository is being conducted iteratively. Each iteration of the design is accompanied by an assessment of the performance of the design and an assessment of remaining design issues. These assessments are used to establish the basis for the next design phase. Design requirements are assessed and revised as necessary before the initiation of each design phase. In addition, the design effort is being closely integrated with the siting effort through the application of an issue identification and resolution strategy.

51816 State implementation of the low-level radioactive waste policy amendments act: A federal perspective. Hinschberger, S.T.; Tait, T.D. *Transactions of the American Nuclear Society (USA)*, 56: 180-181 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The January 1986 enactment of Public Law 99-240, the Low-Level Radioactive Waste Policy Amendments Act of 1985, provided a series of milestones, incentives, and penalties to encourage states and compact regions to fulfill their responsibilities to safely dispose of the low-level radioactive wastes (LLWs) generated within their states. The act ensures that LLW generators will have continued access to the three existing commercial LLW disposal sites through 1992 as long as their states or compact regions are in compliance with milestones prescribed in the amendments act for development of new disposal facilities. Currently, 41 states have joined nine compact regions to provide for the disposal of LLW generated within their borders. Six states have declared their intentions to develop their own individual disposal sites. Two states have contracted with a sited compact region to dispose of their waste, and three states still have not declared their intentions for management of their LLW. The formation of compact regions appropriate to waste disposal needs remains a dynamic process. The need for extensive public involvement in the development of the disposal site has placed further demands on the facility development process. Political, institutional, legal, and economic factors are still materially affecting the development and stability of the regional approach to managing LLW.

51817 The EPA [Environmental Protection Agency] low-level waste standard-a status report. Galpin, F.L.; Gruhlke, J.M.; Holcomb, W.F. *Transactions of the American Nuclear Society (USA)*, 56: 182-183 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The Environmental Protection Agency (EPA) is developing generally applicable environmental standards for land disposal of Atomic Energy Act (AEA) low-level radioactive wastes (LLW) and certain naturally occurring and accelerator-produced radioactive material (NARM) wastes. It is EPA's intention that the LLW standards will protect public health and the environment. The LLW standards would cover disposal of all AEA materials not controlled by other EPA standards and some natural radioactive materials. Coverage of federal waste is significant, because the federal government generates and disposes of >40% of all LLW nationwide, and a uniform standard for all LLW disposal is both a desirable and an achievable goal. Publication of a proposed LLW standard is planned in 1988, and a final standard a year later. This standard will have several important and closely related areas of focus which are discussed in the paper.

51818 Siting a low-level waste facility in California: A success story. Romano, S.A.; Gaynor, R.K. *Transactions of the American Nuclear Society (USA)*, 56: 183 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

US Ecology is the state of California's designee to site, develop, and operate a low-level radioactive waste disposal facility. The facility will meet the state's responsibilities under the Low-Level Radioactive Waste Policy Act as amended. By January 1988, US Ecology narrowed its efforts to two candidate sites. Strong local community support has been expressed for both sites. US Ecology will select a single proposed site for licensing in 1988 and anticipates receiving waste in late 1900 or early 1991. This schedule places California well ahead of the milestones identified in federal law. The success to date in California can be attributed in large part to the open process used to involve citizens' advisory committees (CACs) and the general public at critical stages of the projects.

51819 Site characterization and its role in repository licensing. Stein, R. *Transactions of the American Nuclear Society (USA)*, 56: 186-187 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The Nuclear Waste Policy Act of 1982 and the recently enacted Nuclear Waste Policy Amendments Act of 1987 (the Acts) specify a schedule and a process for the siting of a repository at Yucca Mountain, Nevada. A key step is the collection of geotechnical information as described in a site characterization plan (SCP). The

information to be secured should fully support the technical data needs for a license application to the US Nuclear Regulatory Commission (NRC) for authorization to construct a repository. Although the Acts only require a general plan for site characterization, the US Department of Energy (DOE) has, as a matter of policy, prepared a comprehensive and detailed draft SCP that includes available geotechnical information about the site, a description of the conceptual design of the repository, a description of the waste package, and a detailed discussion of the plans for characterizing the site.

51820 Implementation of 10CFR960 - a regulatory perspective. Hanlon, C.L. *Transactions of the American Nuclear Society (USA),* 56: 187 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The Nuclear Waste Policy Act (NWPA) of 1982 required the US Department of Energy (DOE) to develop general guidelines to be used for recommending sites for repositories. Following extensive consultation with states and tribes, interaction with requisite federal agencies, and concurrence from the US Nuclear Regulatory Commission (NRC), the DOE promulgated its final siting guidelines, 10CFR960, in December 1984. Because of the passage of the Nuclear Waste Amendments of December 1987, (the Amendments) the DOE has reevaluated the continued role of the siting guidelines in the characterization of the Yucca Mountain site in Nevada. The siting guidelines were intended for use by the DOE for systematically evaluating potential sites for both a first and a second repository. They were to be applied rigorously in evaluating a progressively smaller number of sites according to the specific requirements of the NWPA until a single site was recommended for development as a repository. The 10CFR960 contains two major sets of guidelines: postclosure guidelines, which specify factors to be evaluated regarding the potential site's performance after closure; and preclosure guidelines, which specify factors regarding the expected repository performance during construction, operation, closure, and decommissioning. In addition, 10CFR960 contains implementation guidelines, which state how the post- and preclosure guidelines are to be applied and incorporate the consideration of diversity into the identification and evaluation of sites.

51821 US strategy for evaluating the Yucca Mountain, Nevada site. Gertz, C. *Transactions of the American Nuclear Society (USA),* 56: 187-188 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The principal role of a disposal system at Yucca Mountain, Nevada is to isolate waste for a long period into the future. Therefore, the general objective for the entire system is to limit any radionuclide releases to the accessible environment. This objective will be achieved by selecting a site that contains natural barriers against radionuclide releases and by providing an appropriate system of engineered barriers. To provide additional insurance that the system at Yucca Mountain will perform adequately, individual objectives have also been defined for the engineered and natural barriers to radionuclide release and for the design of the disposal system. The general objective for the engineered barriers is that they should limit the release of radionuclides to the natural barriers. The general objective for the natural barriers is that the time of radionuclide travel to the accessible environment through these barriers should be very long. In particular, since groundwater may transport radionuclides, the groundwater travel time should be very long. The general objectives for the design of the disposal system are that its operation should be safe and that its construction should not compromise its ability to meet the other general objectives.

51822 Technology transfer from the US DOE/AECL cooperative project. Baker, R.C. *Transactions of the American Nuclear Society (USA),* 56: 188 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Two main areas of technology transfer exist, one of which is between the United States and other countries. In this case technology is shared or transferred by joint ventures, or cooperative or bilateral agreements. The United States takes either an active role as in the US Department of Energy (DOE) Atomic Energy of Canada Ltd. (AECL) Cooperative Agreement where personnel participate directly in the development of transferable technology, or a more passive role as at Stripa where there is no direct involvement at the experiment level and technology is transferred in the form of documented results. The second area of technology transfer is between US high-level waste projects. This includes technology transfer form the Repository Technology Program (RTP) to a first repository project such as the Nevada Nuclear Waste Storage Investigations (NNWSI). Areas in which the RTP is developing transferable technology and has the expertise and resources to assist the NNWSI in resolving issues are discussed.

51823 Characterizing plutonic rock sites for nuclear fuel waste disposal. Davison, C.C.; Dormuth, K.W.; Whitaker, S.H. *Transactions of the American Nuclear Society (USA),* 56: 188-189 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The Canadian Nuclear Fuel Waste Management Program is currently assessing the concept of disposal of nuclear fuel waste deep in plutonic rock formations. One of the primary objective of the Canadian program is to develop, evaluate, and demonstrate methods for characterizing the physical and chemical properties of potential disposal sites to produce reliable engineering designs and performance assessments of the disposal systems. Transport in groundwater at the site would be the primary mechanism that could bring any radionuclides released from the deep disposal vault to surface during the hazardous lifetime of the waste. Consequently, emphasis is placed on rock mass characterization methods that identify features that are potential pathways for radionuclide migration; quantify the hydrological and geochemical properties that control groundwater flow and radionuclide transport; and determine the geomechanical properties that control the excavation stability and the long-term stability of the rock mass. The methodology being developed consists of field and laboratory tests, in situ monitoring, and mathematical modeling and interpretation. The result is a description of site characteristics in quantitative and qualitative terms, which can be used to support engineering designs, licensing applications, and environmental and safety assessments.

51824 Site characterization activities at Stripa and other Swedish projects. Ahlstroem, P.E. *Transactions of the American Nuclear Society (USA),* 56: 189-190 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The nuclear power program in Sweden consists of 12 reactors. Up to the year 2010, these units will give rise to some 7800 tonne of spent nuclear fuel. Present planning foresees that the spent fuel will be stored at the existing interim storage facility for ≈40 yr before final disposal in a geological repository. Such a repository is planned to be located in bedrock and to be in operation from 2020. A siting application should be submitted to the pertinent authorities around 2000. The application for a siting permit must be based on a system adapted to the site and on a comprehensive analysis of the long-term safety of the system. To perform such adaptation and safety analysis, the site must be carefully characterized. During the 1990s, therefore, it is planned to select and characterize at least two candidate sites. The characterization would take ≈5 yr at least and should therefore start about 1993. Before starting any detailed site investigations, the methods to be used must be developed, carefully tested, and verified. A great part of the ongoing research in Sweden is devoted to these tasks. This paper gives a few examples of projects that are of great importance in this respect: the international Stripa project, the Finnsjon fracture zone study, and the Swedish Hard Rock Laboratory.

51825 HLW [high-level waste] site characterization plan in Switzerland. Thury, M.; McCombie, C. *Transactions of the American Nuclear Society (USA),* 56: 190-191 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The Swiss concept for high-level waste (HLW) disposal is based on the following important premises: (a) Spent fuel from a relatively small nuclear power program is reprocessed in facilities abroad; (b) the vitrified waste will be returned to Switzerland where an intermediate storage period of ≈40 yr allows adequate decay of radiation and heat production; potential sites are being selected and characterized in the northern part of the country where varied sedimentary strata lie above crystalline basement rocks; and (c) if the decision to implement national disposal facilities is taken towards the end of the century, a shaft-accessed mined repository will be constructed in a

suitable host rock at a depth of up to ≈1200 m. The key issues to be addressed in a site characterization program have been discussed at length in many countries. In the paper, the authors comment only on technical aspects. Finally, it should be stressed that a strong connection is seen between the characterization requirements and techniques at potential HLW sites and those at sites for geologic repositories for LLW. The requirements and techniques at potential HLW sites and those at sites for geologic repositories for LLW. The requirements for LLW projects differ quantitatively from those for HLW because of the lower toxicities and shorter time scales associated with LLW; but, the basic issues to be clarified are common. Therefore, deliberate efforts are made in Switzerland to encourage the transfer of information between the corresponding disposal programs and to build both on a common pool of technical expertise.

51826 Characterization program for the Gorleben site in Germany. Schneider, H. *Transactions of the American Nuclear Society (USA),* 56: 191-192 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Since the early 1960s, the radioactive waste disposal policy in the Federal Republic of Germany (FRG) has been based on the decision that all types of radioactive waste are to be disposed of in the deep subsoil, priority being given to the disposal in rock salt formations. Since 1979, the Gorleben salt dome, situated in the northeastern part of the FRG, has been investigated as a candidate repository site for all types of radioactive waste, especially heat-generating waste. The objectives of the investigations and the requirements concerning the site characterization program, essentially derived from the safety criteria, are to provide all necessary data for the site-specific safety assessment, the complete documentation of geological data, and the pertinent information for the detailed layout and optimization of the disposal mine as well as the safe operation of the repository. The site characterization and assessment at Gorleben is expected to last several years, after which the license application documents will be prepared and submitted to the licensing authority. It is scheduled to start up repository operation around the year 2005.

51827 Natural radionuclides in ground waters and cores. Laul, J.C.; Smith, M.R.; Maiti, T.C. *Transactions of the American Nuclear Society (USA),* 56: 162-164 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

investigations of natural radionuclides of uranium and thorium decay series in site-specific ground waters and cores (water/rock interaction) can provide information on the expected migration behavior of their radioactive waste and analog radionuclides in the unlikely event of radioactive releases from a repository. These data in ground waters can provide in situ retardation and sorption/desorption parameters for transport models and their associated kinetics (residence time). These data in cores can also provide information on migration or leaching up to a period of about one million years. Finally, the natural radionuclide data can provide baseline information for future monitoring of possible radioactive waste releases. The natural radionuclides of interest are ^{238}U, ^{234}Th, ^{234}U, ^{230}Th, ^{226}Ra, ^{222}Rn, ^{210}Pb, ^{210}Bi, ^{210}Po, ^{232}Th, ^{228}Ra, ^{228}Th, and ^{224}Ra. The half-lives of the daughter radionuclides range from 3 days to 2.5×10^5 yr. The data discussed are for low ionic strength ground waters from the Hanford (basalt) site and briny ground waters (high ionic strength) and cores from the Deaf Smith salt site. Similar applications of the natural radionuclide data can be extended to the Nevada Tuff repository site and subseabed disposal site. The concentrations of uranium, thorium, radium, lead, and polonium radionuclides are generally very low in ground waters. However, significant differences in disequilibrium exist between basalt and briny ground waters.

51828 Active geothermal systems as natural analogs of HLW repositories. Elders, W.A.; Williams, A.E.; Cohen, L.H. *Transactions of the American Nuclear Society (USA),* 56: 164-165 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Geologic analogs of long-lived processes in high-level waste (HLW) repositories have been much studied in recent years. However, most of these occurrences either involve natural processes going on today at 25°C, or, if they are concerned with behavior at temperatures similar to the peak temperatures anticipated near HLW canisters, have long since ended. This paper points out the usefulness of studying modern geothermal systems as natural analogs, and to illustrate the concept with a dramatic example, the Salton Sea geothermal system (SSGS).

51829 The role of MRS [monitored retrievable storage] and its impact of facility design. Kouts, C.A. *Transactions of the American Nuclear Society (USA),* 56: 177 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The design of the US Department of Energy's (DOE's) monitored retrievable storage (MRS) facility has evolved and will continue to evolve in the role that the facility will play in the overall waste management system. The purpose of this paper is to review the evolution of the role of MRS in the waste management system and its impact on the design of the MRS facility.

51830 The OCRWM [Office of Civilian Radioactive Waste Management] transportation program - an update. Barrett, L. *Transactions of the American Nuclear Society (USA),* 56: 177-178 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The Office of Civilian Radioactive Waste Management (OCRWM) is developing the capability to ship spent nuclear fuel from commercial power plants and high-level radioactive waste from national defense activities to a permanent geologic repository. This paper describes the progress to date in establishing the transportation system. Related activities have centered on three major areas: (1) resolution of institutional issues, (2) cask system development, and (3) support system development. This paper also addresses the implications of the recently enacted Nuclear Waste Policy Act Amendments (NWPAA) on program planning and activities.

51831 The NRC [Nuclear Regulatory Commission] reviews of low-level waste forms and containers. Tokar, M. *Transactions of the American Nuclear Society (USA),* 56: 181-182 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

As stated in the U.S. Nuclear Regulatory Commission (NRC) regulation (10CFR61) for land disposal of low-level radioactive waste (LLW), class B and C wastes must have structural stability. Part 61 also indicates that a structurally stable waste form is one that will maintain its physical dimensions and form under expected disposal conditions, including the weight of overburden and compaction equipment, the presence of moisture and microbial activity, and internal factors, such as radiation effects and chemical changes. However, beyond describing some general characteristics to which the waste must conform, such as limits on the amount of freestanding liquid and the avoidance of pyrophoric material, the regulation provides no guidance on how LLW can be demonstrated to have the required structural stability. That type of guidance is provided in a Technical Position (TP) on Waste Form Stability, which was issued in May 1983. Thus, to meet the requirements of 10CFR61, vendors of high-integrity containers (HICs) and waste solidification agents develop test data for their HIC designs and waste formulations in accordance with recommendations provided in the 1983 TP. The data are then submitted with a topical report for technical review. The technical review is intended to lead to a conclusion that the HIC design or solidification agent formulation meets the stability requirements of Part 61 and thus is acceptable for disposal at a LLW disposal facility.

51832 Organic diagenesis in commercial nuclear wastes. Toste, A.P.; Lechner-Fish, T.J. *Transactions of the American Nuclear Society (USA),* 56: 183-185 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The nuclear industry currently faces numerous challenges. Large volumes of already existing wastes must be permanently disposed using environmentally acceptable technologies. Numerous criteria must be addressed before wastes can be permanently disposed. Waste characterization is certainly one of the key criteria for proper waste management. some wastes are complex melting pots of inorganics, radiochemicals, and, occasionally, organics. It is clear, for

example, that organics have been used extensively in nuclear operations, such as waste reprocessing, and continue to be used widely as solvents, decontamination agents, etc. The authors have analyzed the organic content of many kinds of nuclear wastes, ranging from commercial to defense wastes. In this paper, the finale analyses are described of three commercial wastes: one waste from a pressurized water reactor (PWR) and two wastes from a boiling water reactor (BWR). The PWR waste is a boric acid concentrate waste. The two BWR wastes, BWR wastes Nos. 1 and 2, are evaporator concentrates of liquid wastes produced during the regeneration of ion-exchange resins used to purify reactor process water. In preliminary analyses, which were reported previously, a few know organics and myriad unknowns were detected. Recent reexamination of mass-spectral data, coupled with reanalysis of the wastes, has resulted in the firm identification of the unknowns. Most of the compounds, over thirty distinct organics, are derived from the degradation, or diagenesis, of source-term organics, revealing, for the first time, that organic diagenesis in commercial wastes is both vigorous and varied.

51833 Overview of the DOE [Department of Energy] site characterization program. Kale, S.H. *Transactions of the American Nuclear Society (USA),* 56: 186 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Last year was a period of significant progress and great change in the US Department of Energy's (DOE's) civilian radioactive waste management program. Progress and change were particularly evident in the DOE's site characterization activities. A summary of the overview of the Nevada site characterization consultation draft as well as a summary of current activities to apply the requirements of the 1987 Act to the repository program is included, together with a brief status report on regulatory issues and our cooperation with foreign repository programs.

51834 Site characterization at Yucca Mountain. Blanchard, M.B.; Clanton, U.S.; Alexander, D.H.; Hanlon, C.L.; Younker, J.L.; Voegele, M.D. *Transactions of the American Nuclear Society (USA),* 56: 207 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The Yucca Mountain site, located in south-central Nevada, has recently gained a central position in the US geologic repository program. The goal of the repository is to protect the safety and health of the public for a period of 10,000 yr. The data-base and confidence levels must be developed in a manner consistent with this goal. However, there are no standard criteria that can be used to determine the confidence level required for a given parameter in order to ensure public health and safety. This is in part due to the interdependence of many of the site parameters important to repository performance. The process for refining confidence levels must be iterative in that performance and design analyses can initially be used as a screening tool to eliminate parameters from consideration if they can be shown to have little or no potential impact on repository performance. The parameters required to predict the range of variation in geologic conditions that is likely over the next 10,000 yr and the information necessary to estimate the probabilities of catastrophic geologic events must be obtained and utilized in continued performance and design analyses. Further sensitivity studies utilizing the improved data base can then be conducted and confidence levels for key geotechnical parameters can be refined.

51835 Stratigraphic and structural framework of Yucca Mountain, Nevada. Spengler, R.W.; Fox, K.F. Jr. *Transactions of the American Nuclear Society (USA),* 56: 207-209 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Yucca Mountain is located within the southwestern Nevada volcanic field, ≈140 km northwest of Las Vegas, Nevada, and 50 km northeast of Death Valley, California. The mountain consist of a series of long, linear, north-trending volcanic ridges that approach an 1800-m maximum elevation near The Prow. The broad intermontane alluviated valleys of Crater Flat, the Amargosa Desert, and Jackass Flats, averaging 800 to 1100 m in elevation, form the western, southern, and eastern margins of Yucca Mountain, respectively. North of The Prow, Yucca Mountain merges with other volcanic highlands that flank the southern rim of the Timber Mountain-Oasis Valley caldera complex. The stratigraphy and structure of the area are discussed. Future geologic studies will attempt to determine if faults extend beneath Yucca Mountain, and, if present, their potential effects on the hydrologic and tectonic regimes.

51836 Neotectonics and volcanism at Yucca Mountain and vicinity, Nevada. Fox, K.F. Jr.; Carr, M.D. *Transactions of the American Nuclear Society (USA),* 56: 210-211 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Yucca Mountain is located within the Walker Lane belt, a northwest-trending zone of oroclinal bending and strike-slip faulting that divides the southern Great Basin into two parts: an area to the northeast dominated by extensional faulting and an area to the southwest in which both strike-slip faulting and extensional faulting are important. Post-11 million years before present (m.y.B.P.)-tectonism at or near Yucca Mountain has involved volcanism, oroclinal bending, extensional faulting, and strike-slip faulting. Efforts to characterize the geology and seismicity of the area and the implications thereof are discussed.

51837 Characterization of the subregional groundwater flow system of Yucca Mountain and vicinity, Nevada-California. Czarnecki, J.B. *Transactions of the American Nuclear Society (USA),* 56: 211-212 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The US Department of Energy (DOE) has been directed by Congress to conduct detailed characterization of Yucca Mountain, Nevada, to evaluate its suitability for a mined geologic repository for high-level nuclear waste. Although the repository would be placed in the unsaturated zone beneath Yucca Mountain, an understanding of the regional groundwater flow system is needed in order to (a) assess hydrologic changes that could occur as a result of potential tectonic processes and climatic changes, (b) evaluate the effects of potential groundwater development, and (c) define hydrologic boundary conditions for detailed modeling at the repository site. The US Geological Survey is investigating the regional groundwater flow system for the DOE.

51838 Conceptual model of flow and solute transport in the unsaturated zone beneath Yucca Mountain, Nevada. Hoxie, D.T.; Lewis, B.L. *Transactions of the American Nuclear Society (USA),* 56: 212 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Yucca Mountain, Nevada, is being investigated to determine its suitability for a mined geologic repository for the permanent storage of high-level nuclear waste. If a license is granted, the repository would be constructed in partially saturated welded tuff at ≈300 m below land surface. The presence of an unsaturated zone that ranges from 300 to 750 m thick, combined with an arid environment, is presumed to be a major asset in the ability of the rocks to isolate nuclear waste. Therefore, much of the site-characterization effort will focus on evaluating the hydrology of the unsaturated zone. On the basis of existing data and the general principles of unsaturated flow, a conceptual model of moisture flow in this environment has been developed to guide site characterization.

51839 Mineralogic, petrologic, and geochemical studies of the volcanic rocks at Yucca Mountain, Nevada, for high-level waste disposal. Vaniman, D. (Los Alamos National Lab., CA (USA)); Bish, D.; Broxton, D.; Byers, F.; Carlos, B.; Levy, S.; Chipera, S. *Transactions of the American Nuclear Society (USA),* 56: 213 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Studies of mineralogy, petrology, and geochemistry at a candidate high-level waste repository site must address three primary concerns: (a) possible future geologic events that can compromise waste isolation, (b) possible conflicting site uses, and (c) the natural ability of the site to contain radionuclide waste. Data are being collected to address these concerns for a potential unsaturated repository location at Yucca Mountain, Nevada. The major tuff units underlying the potential repository area at Yucca Mountain extend upward from the thick (≈450 to 700 m) Crater Flat Tuff (≈13.9 million years old), through the informally named tuffs of Calico Hills (≈25 to 110 m, 13.8 million years old) into the Paintbrush Tuff (≈410 to 425 m, 13.4 to 12.9 million years old). The candidate host

rock for a high-level waste repository is within the devitrified Topopah Spring Member of the Paintbrush Tuff. This entire sequence has been faulted and tilted to the east and is covered by the Rainier Mesa Member of the Timber Mountain Tuff (11.6 million years old).

51840 A conceptual design for a nuclear waste repository at the Yucca Mountain site. Hunter, T.O.; Tillerson, J.R.; Stevens, A.L. *Transactions of the American Nuclear Society (USA),* 56: 213-214 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The Nevada Nuclear Waste Storage Investigations project of the US Department of Energy has recently completed a conceptual design for a nuclear waste repository at the Yucca Mountain site. This conceptual design supports the site characterization program by defining a reference description of surface and underground facilities. This reference description would provide a basis for identifying design-related issues and determining the appropriate site characterization activities to obtain needed information about the site. If Yucca Mountain is designated as the site for a license application for the first repository, this conceptual design would form the basis for final design and construction. The repository configuration is described.

51841 Deriving a site characterization program from applicable regulations. Voegele, M.D.; Younker, J.L.; Alexander, D.H. *Transactions of the American Nuclear Society (USA),* 56: 214-215 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The process of deriving a site characterization program from the applicable regulations was approached by the DOE through the use of two basic organizing principles. One organizing principle is a hierarchical structure of questions about regulatory criteria related to the acquisition of site data. This set of questions is called an issues hierarchy, and it provides a topical organizing framework for developing a site characterization program. The second basic organizing principle used by the DOE and its contractors to develop a site characterization program is called performance allocation. For each issue in the issues hierarchy, a resolution strategy is developed. These strategies involve the identification of elements of the disposal system that are relevant to isolation and containment of waste or to radiological safety. It is then possible to identify performance measures and information needed from the site characterization program. This information, coupled with information about confidence in existing data and the confidence required in the data to be obtained, allows the development of testing strategies for field programs.

51842 A top-level strategy for postclosure performance assessment of Yucca Mountain. Bingham, F.W. *Transactions of the American Nuclear Society (USA),* 56: 215-216 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

In defining the studies needed for characterizing the Yucca Mountain site, the US Department of Energy (DOE) began from the following principle: The data that must be collected are the data that the DOE expects to use in demonstrating compliance with the regulations governing a repository. An early step in defining the studies was therefore the formulation of a strategy for demonstrating this compliance; from that strategy the DOE has derived lists of needed data and plans to provide those data. The complete strategy that the DOE formulated is complex enough to fill hundreds of pages in the Yucca Mountain site-characterization plan. At its highest, least detailed level, however, the strategy rests simply on a few fundamental expectations about the behavior of a repository system at Yucca Mountain. A brief explanation of this top level of the strategy is useful for two reasons: It is a simple example of how the detailed strategy was formulated, and it points out the features of the site on which those fundamental expectations are based.

51843 Assessment of an engineered barrier system and design of waste packages. Ramspott, L. (Lawrence Livermore National Lab., CA (USA)). *Transactions of the American Nuclear Society (USA),* 56: 216 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The US Nuclear Regulatory Commission regulation 10CFR60 establishes two major performance objectives for the engineered barrier system (EBS): substantially complete containment within the waste packages for up to 1000 yr and control of the release rate from the EBS for 10,000 yr. The EBS is defined in 10CFR60 as the waste packages and the underground structure, not including shafts and boreholes. The US Department of Energy has adopted a tentative interpretation of the EBS boundary as the edge of the emplacement hole; i.e., the EBS consists of anything inside the emplacement hole. Such a boundary is conservative and simple to define. Because the containment performance objective in 10CFR60 is qualitative, the DOE has tentatively interpreted substantially complete containment in terms of quantitative design objectives. These design objectives are briefly summarized. Assessment of performance of the waste package and EBS is based on allocating performance for various waste package components toward overall design objectives. Then, computer modeling will be used in conjunction with testing to assess whether the allocations are met or exceeded. Because of the unprecedented time period considered, computer modeling is essential. A significant issue will be validation of the computer models.

51844 Preliminary estimates of groundwater travel time at Yucca Mountain. Sinnock, S.; Lin, T. *Transactions of the American Nuclear Society (USA),* 56: 216-218 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

This paper presents the assumptions, methods, and results of a probabilistic approach to the calculation of groundwater travel times to the water table below Yucca Mountain, Nevada. Data to support the analyses were abstracted form formal and informal reports generated by the staff of several organizations participating in the Nevada Nuclear Waste Storage Investigations (NNWSI) project activities, namely, the US Geological Survey, Los Alamos National Laboratory, Lawrence Livermore National Laboratories, and Sandia National Laboratories (SNL).

51845 Assessment of radionuclide retardation. Herbst, R.J. (Los Alamos National Lab., CA (USA)); Canepa, J.A. *Transactions of the American Nuclear Society (USA),* 56: 218-219 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Radionuclide migration in the unsaturated and saturated rock zones composing the Yucca Mountain site may be retarded compared with groundwater movement. Predicting the potential for retardation by processes that include sorption, dispersion, and diffusion requires a thorough geologic characterization of this candidate site for the disposal of radioactive waste, augmented by geochemical laboratory experiments and modeling. The retardation phenomenon is complex. A comprehensive geochemical/physical model capable of predicting radionuclide migration rates in three dimensions with know certainty must be developed. This model will enable formulation of a conclusive statement about the role that retardation phenomena may play in inhibiting radionuclide migration. The experimental data and their interpretation are being incorporated into a geochemical/physical model, TRACR3D, a three-dimensional, transport code, will be used to assess the retardation potential of mineral assemblages in and under the proposed repository horizon in Yucca Mountain. Field tests to validate TRACR3D are also planned.

51846 Assessment of seismic hazards at Yucca Mountain. King, J.L.; Frazier, G.A.; Grant, T.A. *Transactions of the American Nuclear Society (USA),* 56: 219-220 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Seismic hazard information needs, ground motion, faulting, and adverse changes to hydrologic conditions are discussed with respect to pre-closure and post-closure periods of the proposed geologic repository at Yucca Mountain.

51847 Assessment of worker and nonworker radiological safety of a repository. Laub, T.W. *Transactions of the American Nuclear Society (USA),* 56: 220-221 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Preliminary assessments of worker and nonworker radiological safety for both normal and accident conditions during the preclosure

period have been performed for the proposed Yucca Mountain repository. The accident-conditions assessment estimated off-site doses resulting form credible accidents at the repository. Since the purpose of the accident-conditions assessment was to support the development of an initial Q list, worker doses were not calculated. The normal-conditions assessment estimated off-site public doses as well as on-site worker doses resulting form the various anticipated routine radioactive releases and sources. The purpose of the normal-conditions assessment was to evaluate the preliminary Yucca Mountain repository design and identify those operations and aspects that are most important to radiation safety for the repository (e.g., those operations that are the largest contributors to the occupational doses of individual workers). The general approach and some of the results of these safety assessments are summarized.

51848 Foreign cooperative technology development and transfer. Schassburger, R.J.; Robinson, R.A. *Transactions of the American Nuclear Society (USA),* 56: 238-239 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

It is the policy of the US Department of Energy (DOE) that, in pursuing the development of mined geologic repositories in the United States, the waste isolation program will continue to actively support international cooperation and exchange activities that are judged to be in the best interest of the program and in compliance with the Nuclear Waste Policy Act of 1982, Sec. 223. Because there are common technical issues and because technology development often requires large expenditures of funds and dedication of significant capital resources, it is advantageous to cooperate with foreign organizations carrying out similar activities. The DOE's Office of Civilian Radioactive Waste Management is working on cooperative nuclear waste isolation technology development programs with the Organization for Economic Cooperation and Development/Nuclear Energy Agency (OECD/NEA), Canada's Atomic Energy of Canada, Limited (AECL), Sweden, Switzerland, and the Federal Republic of Germany. This paper describes recent technology results that have been obtained in DOE's foreign cooperative programs. Specific technology development studies are discussed for cooperative efforts with Canada, OECD/NEA, and a natural analog project in Brazil.

51849 Site characterization technology. Whitaker, S.H.; Yonk, A.K. *Transactions of the American Nuclear Society (USA),* 56: 239-240 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Site of characterization is the process of field and laboratory investigation by which knowledge and understanding are obtained of the geological setting; the potential paths of fluid flow and waste migration through the rock; the mechanisms of thermal, mechanical, and hydrological response of the rock mass that might either affect the construction and operation of the repository or alter the potential paths of fluid flow and waste migration; and the mechanisms of waste migration and retention along the potential paths. In the geosciences area, each country has tended to focus its site characterization research on those potentially suitable rock types that provide the most flexibility in siting. An important consideration for each national program is the extent to which site characterization methods and techniques developed or demonstrated in one geologic setting on rock type can be transferred to others. In addressing this question three components of site characterization methodology are considered.

51850 Field studies, laboratory experiments, and modeling investigations in fractured media. Deyling, M.A.; Patera, E.S. *Transactions of the American Nuclear Society (USA),* 56: 240-241 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Groundwater flow and radionuclide migration are two critical factors in determining the performance of a high-level nuclear waste (HLW) repository. Flow and transport in fractured media is a complex problem that must be addressed by both the site characterization programs and predictive models. The Repository Technology Program is investigating three aspects of the problem in cooperative efforts with Canada and Sweden as well as in international programs such as INTRAVAL. The methodologies and techniques developed in these programs can be applied to any site investigation that must consider fracture flow and transport of radionuclides along discrete fractures. Laboratory experiments are being performed in cooperation with Atomic Energy of Canada, Limited (AECL) on a large block of granite (≈1 m square) with a discrete fracture to investigate dispersion and diffusion along the fracture. Nonreactive and reactive tracers are used in the experiments. Tracers that include uranine, iodine, and cesium are injected under controlled gradients and sampled uniformly along the fracture discharge surface. Results of the nonreactive tracer experiments will be used to calibrate a radionuclide transport code (FRACFLO) recently developed at Battelle's Office of Waste Technology Development. The calibrated models will then be used to predict the results of experiments that use reactive tracers. The experiment and associated modeling are being considered for use as a test case in the INTRAVAL program.

51851 Instrumentation development. Ubbes, W.F.; Yow, J.L. Jr. *Transactions of the American Nuclear Society (USA),* 56: 240-241 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Instrumentation is developed for the Civilian Radioactive Waste Management Program to meet several different (and sometimes conflicting) objectives. This paper addresses instrumentation development for data needs that are related either directly or indirectly to a repository site, but does not touch on instrumentation for work with waste forms or other materials. Consequently, this implies a relatively large scale for the measurements, and an in situ setting for instrument performance. In this context, instruments are needed for site characterization to define phenomena, develop models, and obtain parameter values, and for later design and performance confirmation testing in the constructed repository. The former set of applications is more immediate, and is driven by the needs of program design and performance assessment activities. A host of general technical and nontechnical issues have arisen to challenge instrumentation development. Instruments can be classed into geomechanical, geohydrologic, or other specialty categories, but these issues cut across artificial classifications. These issues are outlined. Despite this imposing list of issues, several case histories are cited to evaluate progress in the area.

51852 History of WIPP [waste isolation pilot plant] site characterization and lessons learned. Weart, W.D. *Transactions of the American Nuclear Society (USA),* 56: 241 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The Waste Isolation Pilot Plant (WIPP) has been authorized by the US Congress as a research and development facility to demonstrate the safe disposal of radioactive wastes generated by defense program activities. After a 5-yr demonstration phase and on determination of compliance with the Environmental Protection Agency (EPA) standard for geologic repositories, the WIPP facility will become a permanent repository for disposal of defense transuranic wastes. This paper discusses the most significant aspects of the WIPP site characterization and some of the lessons learned in the course of these studies.

51853 Quality assurance requirements for high-level waste form production. Chacey, K.A.; DeLannoy, C.R.; Campbell, M.H. *Transactions of the American Nuclear Society (USA),* 56: 243-244 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The US Department of Energy (DOE) Defense Waste Management Plan has the objective of final disposal for high-level waste (HLW) generated from defense programs. The DOE sites that generate HLW are located at the Savannah River Operations Office in Aiken, South Carolina, the Hanford site in Richland, Washington, and the Idaho Operations Office in Idaho Falls, Idaho. The purpose in the development of a quality assurance (QA) specification for organizations involved in HLW production is to establish uniform requirements that ensure that radioactive waste is converted to a waste form and canistered in such a way that it is acceptable in a federal repository licensed by the US Nuclear Regulatory Commission (NRC). A QA specification has been developed that will be applied to those activities important to certification of the product. The basic requirements are defined in national consensus standards and DOE directives. The supplemental requirements identify the QA criteria associated with HLW production where additional guidance is needed to facilitate the DOE repository licensing process.

51854 **Radionuclides and trace elements in middle Chesapeake Bay sediments.** Gavrilas, M. *Transactions of the American Nuclear Society (USA),* 56: 222-224 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Sediments play an important role in aquatic ecology by serving as a repository for radioactive substances and for soluble chemical pollutants that they may transport over considerable distances and may pass to a higher trophic level by way of bottom-feeding biota. The Chesapeake Bay is a moderately stratified, drowned river valley estuary. The oscillatory flood and ebb of the tidal currents are the most obvious motions in the bay and its tributary estuaries. It is considered that the distribution of most of the pollutants, once diluted by the mixing action of the tidal flow, remains relatively constant for many miles up and down the bay. This paper documents the present status of the radioactivity and of trace elements in sediment samples collected in March 1986 from and extended area around the Calvert Cliffs Nuclear Power Plant.

0530 Environmental Aspects

Refer also to citation(s) 51754, 51755, 51756, 51758, 51759, 51765, 51768, 51771, 51772, 51774, 51775, 51776, 51777, 51779, 51781, 51782, 51857, 51863, 53225

0540 Health and Safety

Refer also to citation(s) 52395, 52890, 53231, 53877

51855 (CONF-881054–Vol.4, pp. 1103-1114) **Sheffield Brook - A case study.** Wilkinson, S.G. (Bechtel National, Inc., Oak Ridge, TN (USA)); Ring, N.C.; McConnel, B.C. Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; Oak Ridge, TN (USA); 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 4.* Order Number DE89014703. Available from NTIS, PC A15/MF A01.

The US Department of Energy is conducting remedial action at various radioactively contaminated sites with Bechtel National, Inc. as its Project Management Contractor. At the Wayne Interim Storage Site in New Jersey, remedial activities have included cleanup of an active stream contaminated with low-level radioactivity, and local, interim storage of the waste. Special requirements associated with these activities included obtaining permits from the US Army Corps of Engineers and the New Jersey Department of Environmental Protection; restoration of wetlands; control of water and sediments; and prevention of contaminant migration during remedial action.

51856 (CONF-881054–Vol.4, pp. 1115-1126) **Decommissioning and remedial action progress at the Weldon Spring Uranium Feed Materials Plant.** Nelson, R.A. (Jacobs Engineering Group, Inc., St. Charles, MO (USA)). Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; Oak Ridge, TN (USA); 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 4.* Order Number DE89014703. Available from NTIS, PC A15/MF A01.

The Weldon Spring Uranium Feed Materials Plant (WSUFMP) played a key role in US uranium production during the years 1957-1966. Prior to its use for uranium production, the area was used by the Army to manufacture TNT during WW II (World War 2). The 217-acre site has been virtually abandoned until 1986. An associated limestone quarry about six kilometers south of the plant was used by the Army for disposal of TNT and wastes. The Department of Energy (DOE) was given responsibility in 1985 for the demolition and cleanup of both the plant and quarry areas. In 1986, the DOE formally began the Weldon Spring Site Remedial Action Project (WSSRAP). Although the first few years of the project will be primarily devoted to regulatory actions through both the NEPA and CERCLA processes, some remedial action activities have already begun. These include identification and removal of RCRA and TSCA wastes which are not radiologically contaminated, thus avoiding questions concerning mixed waste disposal. Efforts to stem offsite release of uranium in surface water flow are also being initiated. The complicated geohydrology of the area allows easy surface and groundwater interaction. Multiple groundwater springs more than two kilometers from the plant site exhibit elevated uranium concentrations. This migration is being mitigated by the construction of surface impoundments and diversion ditches to reduce the surface runoff over contaminated areas of the plant site, which reduces the amount of surface water reaching the groundwater. A status report of the activities at the DOE site is given. Interim remedial actions are presented to reduce the risk to the environment and to onsite workers during the period before regulatory process completion.

51857 (CONF-8810239–Absts., pp. 4.37-4.51) **Bulk water treatment options: a case study.** Land, R.P. (Bechtel National, Inc., Oak Ridge, TN (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; Gaithersburg, MD (USA); 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669. Available from NTIS, PC A24/MF A01.

Remedial action and construction activities at the Department of Energy's Niagara Falls Storage Site and vicinity properties located in northwestern New York resulted in the collection of substantial amounts of construction waste water. Slurry transfer operations and radioactive pitchblende residue dewatering activities generated additional large quantities of contaminated waste water. This presentation addressed the bulk water treatment options which were investigated and the selected treatment protocols and techniques utilized to remove radioactive and chemical trace element contaminants in order to achieve final site closure. Waste management and treatment activity evolved as the complexity of remedial action activities increased. Initially, water management constituted the control of construction water and its treatment requirements were minimal. As the remedial action activities became more complex, there was a corresponding increase of the complexity of the chemical constitution of the waste water and increased treatment requirements. Treatment methods utilized were: (1) use of a filter/demineralizer system, (2) batch treatment using a ferric chloride precipitation process, and (3) batch treatment using a calcium chloride precipitation process. Coordination with the New York Department of Environmental Conservation through the requirements of the State Pollutant Discharge Elimination System permit and additional communication of changes in water management conditions enabled the Sate to issue timely revisions to the site permit, thereby providing adequate protection to the environment with a minimum delay to thee water treatment schedule.

51858 (DOE/OR/21548–078) **Phase 2 groundwater quality assessment for the Weldon Spring site chemical plant/raffinate pits and surrounding vicinity properties: Weldon Spring Site Remedial Action Project: Revision 0.** MK-Ferguson Co., Weldon Spring, MO (USA); Jacobs Engineering Group, Inc., St. Charles, MO (USA). Aug 1989. 159p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-86OR21548. Order Number DE90001125. Available from NTIS, PC A08/MF A01; OSTI; INIS.

This report brings together the most current information on groundwater contamination in the Weldon Spring Chemical Plant/ Raffinate Pits (WSCP/WSRP) area and vicinity properties (WSVP) of the Weldon Spring Site (WSS). In 1988 the monitoring well network was extended by the addition of 33 new wells installed at two depths so they could be used for vertical and lateral characterization. The analytical categories for the study were inorganic anions, nitroaromatic compounds, radiochemical parameters, metals, and total organic carbon. Nitrate contamination in groundwater is a result of leaking raffinate pits. The apparent sources of sulfate contamination are associated with the manufacturing of TNT and DNT. Nitroaromatic compounds are present in the groundwater at the WSS as a result of operations at the WSOW during World War II. Historically, only two monitoring wells indicate uranium levels greater than 40 pCi/L which at this time seems to be the most likely drinking water standard the US Environmental Protection Agency (EPA) will establish. Some metals concentrations in groundwater appear to be connected to the raffinate pits as a point source. Other metals are present in the groundwater, not point sources have been identified for them. The contract required detection limits (CRDLs) for some metals higher than regulatory drinking water standards. 19 refs., 24 figs., 13 tabs.

51859 (DOE/OR/21548–082) **Evaluation of radon emissions and potential control requirements: For the Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri: Revision 1.** MK-Ferguson Co., Weldon Spring, MO (USA); Jacobs Engineering Group, Inc., St. Charles, MO (USA). Aug 1989. 98p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-86OR21548. Order Number DE90001010. Available from NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.

This report provides estimates of radon release rates at the Weldon Spring Quarry (WSQ) for existing conditions and conditions which are expected to exist as the bulk waste is excavated. It also estimates radon release rates for the Temporary Storage Area (TSA). In 1989, Rn-222 concentrations at the fence line exceeded DOE guidelines. Data on working level concentrations at one monitoring station indicate an effective whole body dose rate of 0.75 mrem/hr for radon daughters and 0.74 mrem/hr for thoron daughters at one meter above the quarry waste. Since some of the calculations are based on assumptions, they show only the relative difference in radon release between present conditions and either of two excavation scenarios. They can be used in calculations of public exposure and potential health effects to evaluate the relative merits of each excavation scenario in comparison with present release conditions. The model used to make the estimates in this report is useful for estimating the radon release rate for the entire period of excavation, but it is not suitable for estimating worker exposure over short periods of time. Therefore, worker exposure and appropriate requirements for personal protective equipment will be determined as the excavation proceeds. 19 refs., 13 tabs.

51860 (DOE/RL–88-03) **Defense decontamination and decommissioning program.** Miller, C.; Heine, W.F. Westinghouse Hanford Co., Richland, WA (USA). Feb 1989. 63p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-87RL10930. Order Number DE90001136. Available from NTIS, PC A04/MF A01 - OSTI.

In the United States Department of Energy (DOE) established the Surplus Facilities Management Program (SFMP) to ensure the safe caretaking and decommissioning of both Civilian and Defense "orphan" (no longer part of any currently funded program) surplus facilities. The inventory of the SFMP includes approximately 300 facilities requiring remedial action. The facilities include production and test reactors, chemical processing plants, waste treatment disposal systems, laboratories, and various support facilities. The remedial actions planned for these facilities range from the decontamination of facilities with the potential for reuse, to the complete dismantlement of structures and site restoration to allow unrestricted use. This overview presentation is on the SFMP Defense Decontamination and Decommissioning (D&D) Program, which includes only shutdown DOE-owned facilities used in national defense programs. Included in this presentation are descriptions of the seven Defense D&D program sites, and descriptions of some of their activities. 46 figs.

51861 (DOE/RL–88-23) **Remedial investigation/feasibility study work plan for the 1100-EM-1 operable unit, Hanford Site, Richland, Washington.** USDOE Richland Operations Office, WA (USA). Aug 1989. 262p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-87RL10930. Order Number DE90000762. Available from NTIS, PC A12/MF A01 - OSTI; GPO Dep.

This work plan was initiated and prepared in accordance with US Environmental Protection Agency (EPA) guidance. It provides a description of the tasks required to complete the remedial investigation and feasibility study (RI/FS), which will identify appropriate remedial actions (RA). The tables indicate the section of this work plan where the information indicated can be obtained. This work plan is intended to address investigations and remediation of inactive waste sites within the 1100-EM-1 operable unit in the proposed 1100 National Priorities List (NPL) Aggregate Area. Additional RI/FS work plans will be prepared to address other operable units. 98 refs., 28 figs., 22 tabs.

51862 (JAERI-M–89-045) **Effectiveness of sheltering against internal exposure in nuclear reactor accidents, (1). Survey on the natural air exchange rates and the structural distribution of houses.** Murata, Mikio; Noguchi, Hiroshi; Kato, Shohei; Kokubu, Morinobu; Okuyama, Hiroyasu. Japan Atomic Energy Research Inst., Tokyo (Japan). Apr 1989. 71p. (In Japanese). Order Number DE90710036. Available from NTIS (US Sales Only), PC A04/MF A01.

Sheltering in a house is considered one of the simple and easy protective actions taken in accidental radioactive airborne releases from nuclear power plants. The effectiveness of sheltering for airborne materials with respect to an internal exposure directly depends on natural air exchange rates of houses. This report describes the results of the literature survey and statistical analysis on the natural air exchange rates of Japanese and foreign houses, and describes the statistical data of Japanese houses from the view point of structure. The total number of data 'measured air exchange rates' collected was 211 for Japanese houses and 500 for foreign houses, respectively. The frequency distributions of the air exchange rates well fitted in the lognormal distributions. The geometric mean and geometric standard deviation for the Japanese houses were 0.79 h^{-1} and 2.1. The same values for the foreign houses were 0.33h^{-1} and 0.21. The regression equation obtained to estimate the air exchange rates of Japanese houses is as follows: $Y = - 0.20 + 0.30\ X_1 + 0.083\ X_2 + 0.016\ X_3$ where, Y is the air exchange rate (h^{-1}), X_1 the index of air-tightness of house (1 to 4), X_2 the wind speed (m/s), and X_3 the temperature difference between indoor and outdoor (degC). (author).

51863 (ORNL/RAP/Sub–89/97777/1) **A review of remediation contracting practices.** CH2M Hill Southeast, Inc., Oak Ridge, TN (USA). 26 May 1989. 169p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OR21400. Order Number DE90001843. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

This report presents a review of the remediation contracting practices of a total of 15 selected governmental, private industrial, and remedial action contractor organizations. This review was conducted to support development of a remediation contracting strategy by the Oak Ridge National Laboratory Remedial Action Program. Hazardous and radioactive waste site remediation is a relatively recent development in the United States. While sharing some of the features and technologies of traditional construction, it is essentially a new area of practice for engineers and the construction industry. Furthermore, it is a rapidly developing field, not only with respect to the technologies employed, but also with respect to factors such as standards of practice, risk management, and regulatory requirements. Because of the diversity within the practice of site remediation, the methods used by various organizations for contracting remedial action work also vary. 5 tabs.

51864 Operational readiness/risk assessment at the waste isolation pilot plant. Campbell, T.K. *Transactions of the American Nuclear Society (USA),* 56: 63-64 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The Waste Isolation Pilot Plant (WIPP) is currently preparing to enter its operational phase. In preparation, a risk-based management (RBM) program is being developed to ensure maximum safety and reliability of all aspects of facility operation. Training of workers, preparation of procedures, and development of emergency action plans are examples of activities currently being performed. The RBM program will verify the safety and operability of the facility prior to startup. Planned as part of the RBM is the selective application of the following risk assessment technologies: 1. operational readiness reviews, 2. vulnerability analyses, 3. safety analyses, 4. probabilistic risk assessments, 5. risk/benefit analyses. These tools provide a meaningful risk and operability analysis for startup and a useful end product for managing safety during facility operation.

51865 Facility safety classifications for the waste isolation pilot plant. Dougherty, F.A. *Transactions of the American Nuclear Society (USA),* 56: 64-65 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

A review of Waste Isolation Pilot Plant (WIPP) safety classifications and the corresponding codes and standards was conducted to determine whether differences exist with comparable nuclear power plant classifications. Classification systems and corresponding codes and standards provide a useful basis for establishing design, fabrication, and installation requirements, but an understanding of functional requirements and failure modes and effects is necessary

to achieve performance-based safety classifications. The existence of differences between WIPP and commercial power plants indicates the need to understand the functional requirements of components prior to attempting to judge the adequacy of a component's classification. Designers and regulators need to understand the bases for classifications to ensure that a rational classification system is developed.

51866 Performance assessments for the safety analysis report. Alexander, D.H.; Blanchard, M.B.; Voegele, M.D.; Rickertsen, L.D. *Transactions of the American Nuclear Society (USA),* 56: 166-167 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The application for the license for the geologic repository system will include assessments of the performance of that system. These assessments will be presented in a safety analysis report (SAR) and will involve an evaluation of the site, with appropriate attention to those features of the site that might affect the ability of the repository system to isolate the waste. This paper describes the kind of performance assessments the US Department of Energy (DOE) expects to conduct for the SAR and relates these assessments to the overall problem of issue resolution that is central to the DOE's efforts to characterize the site and to support the siting and licensing decisions that are to be made.

51867 The DOE approach to preclosure repository safety assessment. Eng, C.C.; Michlewicz, D. *Transactions of the American Nuclear Society (USA),* 56: 167 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The Office of Civilian Radioactive Waste Management (OCRWM) in the US Department of Energy (DOE) is responsible for the safe and permanent disposal of spent nuclear fuel and high-level waste in a geologic repository. While the primary focus of this effort is on isolation of the wastes from the biosphere for thousands of years after closure of the repository, DOE is also responsible for assuring that the public, repository workers, and the environment are adequately protected from the activities that will be carried out at the repository prior to its permanent closure. The activities that will be conducted prior to repository closure are described. These activities will present both radiological as well as nonradiological risks to the repository workers and the public. To perform the safety analyses of the repository, DOE is developing a preclosure risk assessment methodology (PRAM) whose objective is to identify and develop a consensus on the analytical procedures, computer codes, assumptions, and data bases to be used and to apply such methodology in addressing repository safety issues.

51868 Performance assessment methodologies for the analysis of high-level nuclear waste repositories. Bonano, E.J.; Cranwell, R.M.; Davis, P.A. *Transactions of the American Nuclear Society (USA),* 56: 168-169 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The Nuclear Waste Policy Act of 1982 requires the US Nuclear Regulatory Commission (NRC) to evaluate a license application submitted by the US Department of Energy to construct high-level nuclear waste (HLW) repositories. The basis that NRC will use to determine the suitability of a potential HLW disposal site is the independent assessment of compliance with existing federal regulations. The regulations set forth in NRC rule 10CFR60 and in the US Environmental Protection Agency's standard 40CFR191 include criteria that must be met to ensure the effective long-term isolation of the waste by the multiple-barrier system (repository and geologic formation) and to minimize the release of radioactivity to the accessible environment. Since 1976, the NRC has contracted to Sandia National Laboratories (SNL) in Albuquerque, New Mexico, the development of methodologies that the NRC will use to assess the performance of HLW repositories. To date, SNL has developed two methodologies: one for bedded-salt formations and another for basalt formations. Work is currently under way to develop a methodology applicable to welded-tuff formations.

51869 Mass transfer and transport in geologic repositories-analytical studies and applications. Pigford, T.H. (Lawrence Berkeley Lab., CA (USA)); Chambre, P.L.; Lee, W.W.L. *Transactions of the American Nuclear Society (USA),* 56: 169-171 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Assessing the long-term performance of geologic repositories for radioactive waste requires reliable quantitative predictions of rates of release of radionuclides from the waste into the rock, transport through the geologic media, cumulative release to the accessible environment, and maximum concentrations in groundwater and surface water. In this paper, the authors summarize their mass transfer approach to making these predictions with respect to far-field transport, near-field transport and intermediate-field transport.

51870 Comparison of source-term calculations using the AREST and SYVAC-vault models. Apted, M.J.; Engel, D.W.; Garisto, N.C.; LeNeveu, D.M. *Transactions of the American Nuclear Society (USA),* 56: 171-173 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

A key supporting step in the validation of performance assessment codes for nuclear waste disposal is to compare verified codes developed for similar analyses. In this paper, we report on the first such comparison of system-level codes for waste package performance assessment, specifically comparison of release calculations by the AREST and SYVAC-Vault models. The purpose of this comparison is to further establish the scientific credibility of these codes for use in predictive assessment of radionuclide release, as well as to identify deficiencies and future improvements.

51871 Current issues in postclosure performance assessment. Eisenberg, N.A.; Van Luik, A.E.; Ross, B. *Transactions of the American Nuclear Society (USA),* 56: 167-168 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Performance assessment, a type of systematic safety analysis, is a method (a) to predict the potential health, safety, and environmental effects of creating and using a nuclear waste repository, (b) to characterize these effects in terms of their magnitude and likelihood, (c) to compare the characterization of these effects to standards of acceptability, and (d) to present the results of these analyses in a format useful to regulators, scientists, and the public. Postclosure performance assessment would thus be those analyses used to predict mined geologic disposal system behavior after permanent closure. The primary focus of and motivation for performance assessment is to evaluate compliance of the repository with regulatory performance standards, although performance assessments are expected to be useful in guiding and evaluating testing, design, and site characterization activities. Given that reduction of modeling uncertainty is an important aspect of obtaining a license, a survey was made of performance assessments for high-level nuclear waste, mined geologic repositories, and of the literature addressing the major issues of performance assessment to identify potentially significant, currently outstanding issues. Given the direction that DOE received from Congress late in 1987, the issues related here are those either directly applicable to or sufficiently general to be potentially applicable to a performance assessment of a Yucca Mountain, Nevada, repository.

51872 Criticality experiments with mixed plutonium-uranium nitrate solution at plutonium fractions of 0.2, 0.5, and 1.0 in annular cylindrical geometry. Lloyd, R.C.; Koyama, T. *Transactions of the American Nuclear Society (USA),* 56: 318-319 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The objective of these criticality experiments is to provide criticality data for Pu + U solutions for optimizing the physical size of equipment during fissile product conversion and storage and for the design of reprocessing plants. Prior to these measurements, little or no criticality data were available for mixed plutonium-uranium solutions in annular geometry. The experiments were performed under a joint Criticality Data Development Program between the US Department of Energy and the Power Reactor and Nuclear Fuel Development Corporation of Japan. The critical experiments were performed in the critical mass facility of Pacific Northwest Laboratory. Criticality measurements were made with (Pu + U) nitrate solutions in a water-reflected annular vessel. The concentration of

(Pu + U) in the nitrate solution was varied and ranged between 61 and 489 g (Pu + U)/l. The ratio of Pu to (Pu + U) in the solution also was varied, with measurements being made at ≈0.52, ≈0.23, ≈0.97. The measurements provide data essential for validating criticality codes that may be used on configurations similar to those of the experiments.

51873 **Validation studies performed with mixed Pu + U aqueous critical experiments in annual geometry.** Smolen, G.R. (Oak Ridge National Lab., TN (USA)); Yamana, H. *Transactions of the American Nuclear Society (USA),* 56: 319-321 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

This paper discusses the results of a calculational study that was performed to validate the SCALE computer code system using data from critical experiments performed with mixed Pu + U agueous solutions. The critical experiments were conducted in an annular vessel where the fissile solution was placed in the annulus, and various inserts and bottles containing fissile solution were located in the inner portion of the vessel. These experimental activities are part of a joint exchange program between the US Department of Energy and the Power Reactor and Nuclear Fuel Development Corporation of Japan in the area of criticality data development. The experiments were conducted at the Battelle Pacific Northwest Laboratory's Critical Mass Laboratory (CML). In summary, calculated multiplication factors have been examined for 18 critical experiments conducted in annular geometry with mixed Pu + U solutions. The results indicate that the SCALE computer code system with CSRL cross sections is capable of accurately modeling mixed fissile systems in annular geometry.

51874 **A neutron-absorbing porcelain enamel for coating nuclear equipment.** Iverson, D.C. *Transactions of the American Nuclear Society (USA),* 56: 329-331 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

In 1985, nuclear safety analyses showed that under upset conditions, strict administrative controls were necessary to limit access to a new processing vessel for enriched uranium service at the Savannah River Plant (SRP). In order to increase the level of nuclear safety associated with that vessel, the traditional methods of incorporating neutron absorbers (borated stainless steel, boral, cadmium foil, etc.) were reviewed, however, process conditions did not permit their use. A neutron-absorbing porcelain enamel containing large amounts of cadmium and boron was developed as a safe, cost-effective alternative to traditional neutron-absorbing methods. Several pieces of coated process equipment have been installed or are planned for installation at SRP.

51875 **Instrumentation for criticality safety control in a fuel fabrication facility.** Honkonen, D.L. *Transactions of the American Nuclear Society (USA),* 56: 333-334 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Many different forms of enriched uranium-aluminum alloy components and waste are generated in the fuel fabrication facility at Savannah River Plant (SRP). Accordingly, a variety of different instruments are used to help prevent accidental criticality with these materials. This paper describes some of these instruments and some novel uses to which they are put in the fuel fabrication process and instrumentation of criticality safety control.

0550 Safeguards, Inspection, and Accountability

Refer also to citation(s) 52332

51876 (AD-A–209433/2/XAB) **System reliability.** Barlow, R.E. California Univ., Berkeley, CA (USA). 1988. 7p. Available from NTIS, PC A02/MF A01.

Pub. in Kotz-Johnson Encyclopedia of Statistical Sciences, Vol. 9, 150-154(1988).

The purpose of a system-reliability analysis is to acquire information about a system of interest relative to making decisions based on considerations of availability, reliability, and safety as well as any inherent engineering risks. Broadly speaking, there are two important aspects to a system analysis: (1) an INDUCTIVE ANALYSIS stage and (2) a DEDUCTIVE ANALYSIS stage. In the INDUCTIVE ANALYSIS stage we gather and organize available information on the system. The author defines the system, describes its functional purpose, and determines its critical components. The DEDUCTIVE ANALYSIS aspect of a system reliability analysis answers the question: HOW can a system fail (or succeed) or be unavailable. A logic network (or fault tree if we are failure oriented) is often the best device for deducing how a major system failure event could possibly occur.

51877 (LA–11639-MS) **The analyses of neutron coincidence data to verify both spontaneous-fission and fissionable isotopes.** Menlove, H.O.; Abedin-Zadeh, R.; Zhu, R. Los Alamos National Lab., NM (USA). Aug 1989. 46p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. Order Number DE90000990. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

For neutron coincidence counter applications to the assay of plutonium samples, various calibration methods can be used to evaluate the data. The reals (R) and totals (T) rates can be used to predict the induced-fission rate. When this is done, the results give information related to both the spontaneous-fission isotopes and the fissionable isotopes (induced fission). The combination of both approaches is less sensitive to the plutonium isotopic uncertainties than the normal spontaneous-fission approach. Five calibration methods are evaluated for a wide variety of sample types to emphasize the advantages and disadvantages of the methods. For certain sample categories with well-defined geometries, such as light-water reactor and fast breeder reactor mixed-oxide fuel assemblies, a method is presented that allows the verification of the declared isotopics within given constraints. Recommendations are given on analysis procedures to reduce the assay errors for coincidence counting of any type of sample. 15 refs., 11 figs., 15 tabs.

51878 (ORNL/FTR–2447) **[Review of process monitoring safeguards technology for reprocessing facilities]: Foreign trip report, November 8, 1986–November 14, 1986.** Ehinger, M.H. Oak Ridge National Lab., TN (USA). 4 Dec 1986. 69p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89017292. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The Oak Ridge National Laboratory (ORNL) has an interagency agreement with the International Safeguards Project Office (ISPO) to perform Task C.59, "Review of Process Monitoring Safeguards Technology for Reprocessing Facilities." The traveler participated in discussions with staff members of the IAEA on the status and planned activities associated with the task. The traveler attended an International Symposium on Nuclear Material Safeguards, held in Vienna every four years, and presented two papers concerning activities associated with Task C.59. The papers generated significant interest among meeting participants. Discussions with symposium participants and IAEA staff members showed C.59 activities are pivotal to future safeguards applications. A focus of attention for the final work on Task C.59 will be the additional areas of interest in international safeguards that can be addressed at ORNL. A local American Nuclear Society (ANS) chapter meeting was also attended in which radiological doses to the population as a result of the Chernobyl accident were discussed.

51879 (SAAS–376) **Safeguards at the Central Institute for Nuclear Research at Rossendorf/GDR.** Helming, M.; Rehak, W.; Schillert, B. Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic). 1989. 22p. (CONF-8811274–: IAEA basic international safeguards training course, Tashkent (USSR), 14-25 Nov 1988). Order Number DE90606937. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Experience in the implementation of domestic and international safeguards at the Central Institute for Nuclear Research at Rossendorf is reported covering the following topics: overview of the main nuclear installations belonging to the Institute; structure of its material balance areas; responsibilities for the different aspects of accounting for and control of nuclear material at facility level; the various types of nuclear materials handled and their flow, accessibility and strategic significance; the assessment of IAEA safeguards effectiveness. 2 tabs., 2 figs. (author).

51880 DOE enrichment plants-safeguards means business. Donnelly, R. *Transactions of the American Nuclear Society (USA),* 55: 1 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

The Portsmouth Gaseous Diffusion Plant, owned by the US Department of Energy (DOE) and operated by Martin Marietta Energy Systems, Inc., is a full service enrichment plant. Its long enriching cascade can process uranium hexafluoride (UF_6) feeds at almost any ^{235}U level and can produce UF_6 over the complete spectrum from depleted to very highly enriched uranium. The DOE uranium enrichment program is a government-owned enterprise operating as a business. The operating concerns of the DOE uranium enrichment plants and their safeguards programs have evolved together over the past three decades, and that evolution will likely continue. As the risk associated with possession, processing, and shipment of strategic nuclear material increased, the protection and control of it increased; as the value of the product grew with time, better ways were found to measure and conserve it. In each of these areas, safeguards objectives and the business requirements of the plant are complementary, and the progress made in one area has been reflected by progress in the other. The plant's material control and accountability program has become crucial to such business requirements as quantifying the enriched uranium (separative work units) produced in each monthly period and convincing financial auditors that the multibillion dollar enriched uranium assets located at the Portsmouth plant are properly stated.

51881 Operator experiences with international safeguards in the back end of the fuel cycle-geared to economic efficiency. Huppert, K.L. *Transactions of the American Nuclear Society (USA),* 55: 1-2 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

The nuclear industry in the Federal Republic of Germany (FRG) started at an early date to close the nuclear fuel cycle. Today, facilities operate for the enrichment of ^{235}U, for its conversion, and for the fabrication of both uranium and uranium-plutonium mixed-oxide fuel elements. Pilot plants for the chemical processing of spent-fuel elements, as well as for the vitrification of the highly radioactive waste solutions, are also being operated on an industrial scale. This development has been generously sponsored by the Federal Minister of Research and Technology. This paper, which reports on the commitment of industry in the FRG to close the back end of the nuclear fuel cycle and the interaction of industrial activities with international safeguards, includes a discussion of efforts to implement a second way of entsorgung, the direct disposal of spent-fuel elements. International safeguards in German nuclear installations have proven to be sufficient to provide a high degree of guarantee against diversion at the various stages of the fuel cycle. Moreover, the state of the art that has been achieved and the improvements discussed will enable both the inspectorates and the operator to exercise efficient safeguards in future plants, including bulk-handling facilities, without impairing the economy of operation of the facilities.

51882 The relationship between plant operators and safeguards inspectors-experience of Euratom. Van Der Stricht, E. *Transactions of the American Nuclear Society (USA),* 55: 2-3 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

This paper presents particular features and goals of Euratom safeguards and its place in the international safeguards world beside the International Atomic Energy Agency (IAEA). This presentation deals mainly with problems of interrelationships resulting from the more or less continual presence of international inspectors in important bulk-handling facilities under Euratom safeguards. Such relationships between the operator and the inspector have developed from an initial stage relating to the novelty of subject to a more or less educational type of interaction, i.e., to one characterized by a rather general acceptance of the inspectors' activities at the plant. Over the last 20 yr or so, there has been an increased awareness of the technical and political importance and implications of safeguards matters. The roles played by internal and external factors are put into perspective in this paper.

51883 Facility operations/safeguards interface, a DOE [Department of Energy] view. Hammond, G.A. *Transactions of the American Nuclear Society (USA),* 55: 3-4 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

Facility operations and new facility designs must incorporate a number of considerations that should be mutually supportive. Operational considerations dominate, because without the need to operate or build the facility there would be no need for supporting services. It is important to recognize that these supporting services cannot be treated in isolation. Together, they form a conglomerate or coherent whole that must interface with facility design and operations. This conglomerate of interactive professions and activities comprises not only safeguards, but also health, safety, criticality control, environmental protection, nuclear materials management, waste management, transportation, personnel assurance, and human reliability. As a conglomerate, however, the solution is not so obvious without recognizing the interrelationship and need for coordination, communication, and cooperation among the shareholders. An improved interrelationship will be difficult, but important. An efficient operating and processing facility is usually based on will-engineered and well thought out steps, and in turn, offers technological benefits to safeguards.

51884 IAEA [International Atomic Energy Agency]/facility interface in international safeguards. Schurict, V. *Transactions of the American Nuclear Society (USA),* 55: 4 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

Many interactions take place between the International Atomic Energy Agency (IAEA) and facilities within a state. The main interface is the inspection by IAEA inspectors at a facility. In the course of verifying a state's reports to the IAEA on facility matters, further indirect interactions take place between a facility and the IAEA via the State System for Accounting for and Control of Nuclear Material. In addition, other formal and/or informal contacts between IAEA staff and facility management and/or staff are essential for implementation of effective and efficient international safeguards. The IAEA/facility interface is determined by legally binding documents (safeguards agreements, subsidiary arrangements, facility attachments) that are the framework for applying international safeguards. These documents define obligations, conditions, restrictions, etc., for the actual conduct of inspections and for other safeguards-related activities at the facility by IAEA inspectors. There are some general problems in implementing safeguards at existing bulk-handling facilities that result from the fact that such facilities have been designed in the past without due consideration of international safeguards. Examples of this situation are given. Close cooperation between states, operators, and the Department of Safeguards of the IAEA is an indispensable prerequisite to overcome existing and expected problems in applying safeguards.

51885 Bridging the interface-the human factor. Ellis, J.H. *Transactions of the American Nuclear Society (USA),* 55: 5 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

The safeguards world has focused on the technical aspects of accounting for nuclear materials, developing sophisticated measuring devices, analytical methods, standards programs, and statistical models for use by the operating facilities. These devices and techniques should permit facility manages to know and state the plant nuclear material inventory with a high degree of certainty. However, experience at the Hanford Purex plant has shown this is not always the case. It has been a challenge to overcome the personnel-related problems on a near-term basis and to ensure reliable, long-term performance in accounting for the plant's nuclear materials. It was determined that the primary problem was one of attitude, and it was prevalent in all levels of personnel in the plant. The prescription developed at Purex contained the following ingredients: commitment, training, resources, and follow up. These elements have been built into the accountability system for Purex and the results look very promising. A significant improvement in attitude is evident, and problems related to accountability have been reduced.

51886 Integrated safeguards and facility design and operations. Tape, J.W. (Los Alamos National Lab., NM (USA)); Coulter,

C.A.; Markin, J.T.; Thomas, K.E. *Transactions of the American Nuclear Society (USA),* 55: 5-6 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

The integration of safeguards functions to deter or detect unauthorized actions by an insider requires the careful communication and management of safeguards-relevant information on a timely basis. The traditional separation of safeguards functions into physical protection, materials control, and materials accounting often inhibits important information flows. Redefining the major safeguards functions as authorization, enforcement, and verification, and careful attention to management of information from acquisition to organization, to analysis, to decision making can result in effective safeguards integration. The careful inclusion of these ideas in facility designs and operations will lead to cost-effective safeguards systems. The safeguards authorization function defines, for example, personnel access requirements, processing activities, and materials movements/locations that are permitted to accomplish the mission of the facility. Minimizing the number of authorized personnel, limiting the processing flexibility, and maintaining up-to-date flow sheets will facilitate the detection of unauthorized activities. Enforcement of the authorized activities can be achieved in part through the use of barriers, access control systems, process sensors, and health and safety information. Consideration of safeguards requirements during facility design can improve the enforcement function. Verification includes the familiar materials accounting activities as well as auditing and testing of the other functions.

51887 Effective safeguards in a commercial reprocessing plant. Marsh, R.D.; Bennett, W.E.; Foulkes, R.W. *Transactions of the American Nuclear Society (USA),* 55: 6 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

Large reprocessing plants require special attention if they are to be safeguarded effectively, and since a number of new plants are under construction or being planned, it is highly important to resolve the technical and logistic issues they will present to the safeguards inspectorates. In the United Kingdom, the THORP plant, which will reprocess up to 1200 t of irradiated oxide fuel per year, is under construction and is due to commence operation in the early 1990s. The development of procedures for safeguarding this plant is of immediate concern to the owner, British Nuclear Fuels, Ltd. (BNFL), but also to the safeguards community and the nuclear power industry worldwide. Last year, BNFL published its views on the need for a fresh and imaginative approach to safeguarding reprocessing plants, and suggested ways in which a combination of technical measures, linked to a flexible application for diversion detection criteria, could provide an effective and efficient safeguards strategy. The present paper describes how that approach could be implemented in THORP with reference to specific design features, and particularly addresses the question of verification. It is a paper about practicalities; it describes materials measurement systems, inferential measurement techniques, and the use of process models, and discusses the techniques available to the inspectorates to verify the operator's data.

51888 Some thoughts on interface between international safeguards and facility operation. Iwamoto, H. *Transactions of the American Nuclear Society (USA),* 55: 6-7 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

International safeguards, which are applied by the International Atomic Energy Agency (IAEA), should be effective and efficient. For those countries that have ratified the nuclear Non-Proliferation Treaty (NPT), the application of safeguards should also be in compliance with the relevant terms of the NPT. Safeguards are applied exclusively to verify that nuclear material is not diverted toward the manufacture of nuclear weapons or other nuclear explosive devices. For Japan, a joint committee, composed of representatives from the government of Japan and from the IAEA, was established. Its purpose is to review and facilitate the application of Japan's safeguards agreement, as well as to benefit from the experience gained to date and from new technological developments in the field of safeguards. Japan initiated the Japanese Support Program for Agency Safeguards (JASPAS) in 1981. The aim of JASPAS is to support IAEA activities relative to the development of effective and efficient safeguards. This program contains five different categories and, at present, JASPAS is carrying out 29 tasks. The major executing organizations of JASPAS are the Power Reactor and Nuclear Fuel Development Corporation and the Japan Atomic Energy Research Institute. These two organizations are the most heavily inspected by the IAEA.

51889 A new safeguards concept at ALKEM MOX fuel fabrication plant. Haas, E.; Hagenberg, W.; Wachtendonk, H.J. *Transactions of the American Nuclear Society (USA),* 55: 7-8 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

The first safeguards approach developed for the mixed-oxide (MOX) fuel fabrication plant ALKEM included all safe-guards features as designed for the International Atomic Energy Agency for this type of plant in the early 1970's. Within recent years a new inspection approach was proposed in which earlier Euratom inspection practices were resumed. Developments related to the internal material control procedures were taken into account, and the willingness of the operator to give full access at any time to the material in the process and to the relevant operating records was considered. The ability to trace and differentiate individually defined quantities of nuclear material by nondestructive assay (using the material's element and isotope composition) was identified as the cornerstone of this new inspection approach. On the basis of this approach, a new facility attachment was agreed upon in June 1986, realizing the above ideas. Also included were batchwise balancing of nuclear material by the operator as well as independent balancing and verification possibilities for inspectors.

51890 The interaction of international safeguards with facility design. Weh, R. *Transactions of the American Nuclear Society (USA),* 55: 8-9 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

When designing a nuclear facility, international safeguards, like radiation protection or criticality control, represents only one of a large number of viewpoints that have to be considered. Moreover, it is difficult to establish an order of priority. This particularly applies if human safety is involved, but there are at least two more issues that decisively influence the safeguards concept. First, in the case of a commercial facility, economic efficiency must be considered if safeguards measures lead to additional costs. Second, the nature of the licensing procedure according to the German Atomic Act, together with the special nature of the Euratom Treaty regarding reprocessing, are fundamentally important. In addition, some national regulations are counterproductive to safeguards demands and vice versa. The problem is explained and investigated using the Wackersdorf Reprocessing Plant as an example for a commercial-sized bulk-handling facility.

51891 Design of an error-free nondestructive plutonium assay facility. Moore, C.B.; Steward, W.E. *Transactions of the American Nuclear Society (USA),* 55: 9 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

An automated, at-line nondestructive assay (NDA) laboratory is installed in facilities recently constructed at the Savannah River Plant. The laboratory will enhance nuclear materials accounting in new plutonium scrap and waste recovery facilities. The advantages of at-line NDA operations will not be realized if results are clouded by errors in analytical procedures, sample identification, record keeping, or techniques for extracting samples from process streams. Minimization of such errors has been a primary design objective for the new facility. Concepts for achieving that objective include mechanizing the administrative tasks of scheduling activities in the laboratory, identifying samples, recording and storing assay data, and transmitting results information to process control and materials accounting functions. These concepts have been implemented in an analytical computer system that is programmed to avoid the obvious sources of error encountered in laboratory operations. The laboratory computer exchanges information with process control and materials accounting computers, transmitting results information and obtaining process data and accounting information as

required to guide process operations and maintain current records of materials flow through the new facility.

51892 Experience of developing an integrated nondestructive assay system. Hsue, S.T. (Los Alamos National Lab., NM (USA)); Baker, M.P. *Transactions of the American Nuclear Society (USA),* 55: 9-11 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

A consortium of laboratories is collaborating with the Savannah River Plant to develop an integrated system of state-of-the-art nondestructive assay (NDA) instrumentation to provide nuclear materials accounting and process control information for a new plutonium scrap recovery facility. Individual instruments report assay results to an instrument control computer (ICC); the ICC, in turn, is part of a larger computer network that includes computers that perform process control and materials accounting functions. The design of the integrated NDA measurement system is shown. Each NDA instrument that is part of the integrated system is microcomputer-based and thus is capable of stand-alone operation if the central computer is out of service. Certain hardware features, such as microcomputers, pulse processing modules, and multichannel analyzers, are standardized throughout the system. Another standard feature is the communication between individual NDA instruments and the ICC. The most unique phase of the project is the integral staging. The primary purpose of this phase is to check the communications between various computers and to verify the ICC software during the operation of the NDA instruments. Implementing this integrated system in a process environment represents a major step in realizing the full capabilities of modern NDA instrumentation.

51893 Application of EMCAS timeliness model to the safeguards/facility interface. Eggers, R.F.; Giese, E.W. *Transactions of the American Nuclear Society (USA),* 55: 11 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

The Hanford operating contractor has developed a timeliness model for periodic mass balance tests (MBTs) for loss of special nuclear material (SNM). The purpose of the model is to compute the probability that an adversary will be detected by a periodic MBT before he could escape from a facility with stolen SNM using stealth and deceit to avoid detection. The model considers (a) the loss detection sensitivity of the MBT, (b) the time between MBTs, and (c) the statistical distribution of the total time required to complete stealth and deceit strategies. The model shows whether or not it is cost-effective to conduct frequent MBTs for loss and where improvements should be made. The Evaluation Methods for Material Control and Accountability Safeguards Systems (EMCAS) timeliness model computes the loss detection capability of periodic materials control and accounting (MC&A) tests in terms of (a) the ability of the test to detect the specified target quantity and (b) the probability that the MC&A test will occur before the adversary can complete the sequence of stealth and deceit strategies required to avoid detection.

51894 The development and experience of safeguards at the Dutch and German uranium enrichment plants (URENCO). Dekker, B.G.; Steinebach, E.F.M. *Transactions of the American Nuclear Society (USA),* 55: 12 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

In 1972, the first URENCO enrichment plants, the Dutch pilot plant (SP1) and the German pilot plant (SP2), both located in Almelo, Netherlands, started operation. This paper describes the safeguards development and experience at both plants. Both plants had nominal capacities of 25-t solid waste/yr. Experiences gained during commissioning and operation of the pilot plants were utilized in the design of the joint 200-t solid waste/yr demonstration plant (SP3) at Almelo and later commercial plants at Almelo (SP4) and Gronau, Federal Republic of Germany (UTA 1). Since the introduction of Euratom safeguards in the initial Almelo facilities, the implementation of full international safeguards has developed to the required level of nonproliferation assurance for both the Almelo and Gronau plants. Inspection practices have developed to an efficient execution of the activities as laid down in the FA. Research and development to solve the problems with NDA measurements in cascade halls will continue. The operators would welcome any NDA method, provided the measurement results are obtained quickly and show reliable low-enriched uranium confirmation. Expert opinions still differ as to whether this is an achievable goal.

51895 Gamma techniques for IAEA [International Atomic Energy Agency] safeguards at centrifuge enrichment cascades. Aaldijk, J.K.; de Betue, P.A.C.; van der Meer, K.; Harry, R.J.S. *Transactions of the American Nuclear Society (USA),* 55: 13 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

On February 4, 1983, the Hexapartite Safeguards Project (HSP) concluded that the safeguards approach involving limited frequency unannounced access (LFUA) by International Atomic Energy Agency (IAEA) inspectors to cascades areas together with inspection activities outside the cascade areas meets the IAEA safeguards objectives in an effective and efficient way. In this way, the risks of revealing sensitive information were also minimized. The approach has been defined clearly and unambiguously, and it should be applied equally to all technology holders. One of the conclusions of the HSP was that a nondestructive assay go/no-go technique should be used during the LFUA inspections in the cascade areas of centrifuge enrichment plants. The purpose is to verify that the enrichment of the product UF_6 gas is in the range of low-enriched uranium (LEU), i.e., the enrichment is below 20%.

51896 Material accountancy in the Ningyo-Toge uranium enrichment pilot plant. Akiba, M; Iwamoto, T.; Hori, M.; Ikeda, K.; Tani, A. *Transactions of the American Nuclear Society (USA),* 55: 13-14 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

The uranium enrichment pilot plant at PNC Ningyo-Toge Works, Japan, started operation in August 1979. Since then, inspection activities by the government of Japan and the International Atomic Energy Agency (IAEA) have been carried out. A basic measure of safeguards is evaluation of material unaccounted for (MUF) by closing the material balance. As the plant now produces uranium of <5% enrichment, a material balance is closed only once a year. Until now, eight physical inventories have been taken. This paper describes the operator's procedures for material accountability and the values of MUF reported to the government of Japan and the IAEA.

51897 Stationary and portable instruments for assay of HEU solids holdup at Y-12. Russo, P.A. (Los Alamos National Lab., NM (USA)); Sprinkle, J.K. Jr.; Brumfield, T.L.; Gunn, C.S.; Watson, D.R. *Transactions of the American Nuclear Society (USA),* 55: 14-16 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

Two NaI(T1)-based instruments, one stationary and one portable, designed for automated assay of highly enriched uranium (HEU) solids holdup, are being evaluated at the scrap recovery facility of the Oak Ridge National Laboratory Y-12 Plant. The stationary instrument, a continuous monitor of HEU within the filters of the chip burner exhaust system, the CHip burner filter Uranium Monitor (CHUM) instrument, measures the HEU deposits that accumulate erratically and rapidly during chip burner operation. The portable system, the powder transfer piping (PXP) instruments, was built to assay HEU in over 200 ft of elevated piping used to transfer UO_3, UO_2, and UF_4 powder to, from, and between the fluidized bed conversion furnaces. This instrumentation effort demonstrates that simple calibration models can often be applied to unique measurement geometries, minimizing the otherwise unreasonable requirements for calibration standards and allowing extension of the measurements to other process locations. The presentation includes the designs of the PXP and CHUM instruments and of the calibration standards. The calibration procedures and verification methods are described. Comparisons of PXP and CHUM assays with results obtained by cleanout and recovery of process material are shown.

51898 A confirmatory measurement technique for highly enriched uranium. Sprinkle, J.K. Jr. (Los Alamos National Lab., NM (USA)); Russo, P.A.; Goldman, A.; Stovall, L.A.; Brumfield, T.L.; Gunn, C.; Watson, D. *Transactions of the American Nuclear Society*

(USA), 55: 16-17 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

Present US Department of Energy regulations require that the receiver of a special nuclear material (SNM) shipment perform an input accountability measurement within 10 calendar days of receipt of the shipment. In cases where this measurement is not possible, a confirmatory measurement may be used on an interim basis to accept the transfer. It has been proposed that a confirmatory measurement should deal with the material control issue, specifically, whether any SNM has been diverted or lost. In this definition of a confirmatory measurement, the result is reported in counts per second. If a confirmatory measurement demonstrates that no SNM is missing, the transfer could be considered successful and the 741 form could be closed. The proposed definition of a confirmatory measurement leads to certain requirements for the actual measurement system for highly enriched uranium: (1) A measurement precision of 1% or better (one relative σ) on a unique attribute of the SNM is required. (2) If the confirmatory measurement is used to deduce a sample mass, a nominal measurement accuracy of 10% (1σ) is reasonable. (3) Short count times with a minimum of sample preparation are needed. (4) Minimal cost for capital equipment and the personnel to operate it are necessary. (5) The confirmatory measurement should be hard to fool with a bogus item.

51899 Assigning mass values to in-house standard UF_6 cylinders. Goldman, A. (Los Alamos National Lab., NM (USA)); McGuire, D.; Croarkin, C. *Transactions of the American Nuclear Society (USA)*, 55: 16-17 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

The purpose of this paper is to describe a method of assigning mass values to in-house standard (IHS) UF_6 cylinders. The products of the UF_6 industry are large steel cylinders filled with nuclear material with gross weights on the order of 15 t. Error sources were suspected because of scale loading procedures and air buoyancy corrections when calibrating with industry standard iron weights. To overcome these potential error sources, a series of six replica mass standards (RMSs) were fabricated to duplicate the geometry, displacement, and approximate mass of the UF_6 cylinders used by the nuclear industry. Duplicate cylinders of each of three sizes were prepared-one filled with stable materials with a total weight approximately equal to the gross (full) weight and one left empty to approximate the empty (tare) weight of production cylinders of each size. The mass values and uncertainties of the six RMSs were established in 1977 by the US National Bureau of Standards. A Fast 4-1's Series method of mass value is used to assign values of IHS. This method is but one of many least-squares techniques that are acceptable for standardizing an IHS.

51900 Current SGS [segmented gamma-ray scanner] technology. Bjork, C.W. (Los Alamos National Lab., NM (USA)). *Transactions of the American Nuclear Society (USA)*, 55: 18 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

The assay of scrap and waste in the nuclear fuel cycle continues to be an important component in nuclear material accountability. The segmented gamma-ray scanner (SGS) is an important measurement tool for the class of low-density materials. Segmentation and transmission measurement at each segment provide assay capability to items having some degree of heterogeneity in the volumes of their containers. In support of the safeguards efforts at the Savannah River Plant and the Los Alamos plutonium facility, new SGSs have been designed, fabricated, and tested by the Los Alamos safeguards assay group. This new generation of scanners is highly automated and provides special features to improve performance. Three designs currently exist: a stand-alone unit with variable geometry, an SGS with only a bearing and turntable within a well beneath a glovebox, and another in-the-glovebox unit featuring elevation and rotation mechanisms within a glovebox well.

51901 Smoothing the interface between SNM monitors and facility operations. Fehlau, P.E. (Los Alamos National Lab., NM (USA)). *Transactions of the American Nuclear Society (USA)*, 55: 18-19 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

Special nuclear materials (SNM) monitors are an important part of facility safeguards that have progressed from moderately sensitive pedestrian monitors for searching pedestrians, packages, and motor vehicles. The highly sensitive monitors are also more vulnerable to interference from facility operations with SNM. Good practice locates SNM monitors well away from operations involving SNM but sometimes a monitor must be operated in a much less than optimum environment, for example, adjacent to process streams, an SNM conveyor, or an SNM storage vault. During the past 4 yr, the advanced nuclear technology group at Los Alamos National Laboratory has assisted in resolving these problems by devising aftermarket remedies and by developing new monitoring methods and equipment. The SNM process areas have radiation fields that include direct and scattered gamma rays and neutrons. A multiple-strip (grating) collimator was developed that fits inside a standard U-shaped lead detector shield to narrow the detector's field of view. Prompt fission radiation from critical assembly operation also interferes with SNM monitor operation. Hand-held monitors can cope with high and variable background in some cases. Finally, prototype plutonium monitors have been developed that detect neutrons alone.

51902 Continuous measurement of uranium concentrations with the laser spark. Gutmacher, R.G. (Los Alamos National Lab., NM (USA)); Cremers, D.A.; Wachter, J.R. *Transactions of the American Nuclear Society (USA)*, 55: 19-20 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

Continuous measurement of uranium concentrations in liquid streams is necessary for criticality safety, process control, and nuclear materials accounting. The solutions may contain high concentrations of fission products or neutron emitters that interfere with nondestructive gamma-ray, neutron, or X-ray techniques. A technique that is rapid, noninvasive, unaffected by radioactivity, and that requires neither sample handling nor preparation is desirable. The laser spark, more formally known as laser-induced breakdown spectroscopy (LIBS), appears to have all of these properties. The use of LIBS to analyze static uranium solutions at concentrations of interest for process stream analysis has been successfully demonstrated. A test loop and flow cell have been constructed and experiments are being conducted on flowing streams. The results of these experiments will be reported. The authors plan to investigate its applicability to the determination of uranium, plutonium, americium, thorium, zirconium, and others in the future. It is probably impossible to measure isotopic compositions because the high electrical field in the laser spark produces Stark broadening of the uranium emission lines.

51903 Plutonium assay of large waste burial containers at the Pacific Northwest Laboratory. Haggard, D.L.; Newman, D.F. *Transactions of the American Nuclear Society (USA)*, 55: 20-21 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

As one phase of an upgrade program at one of the Battelle Pacific Northwest Laboratory facilities, two plutonium glovebox hoods were replaced. They were dismantled, packaged in plastic for contamination control, and loaded into waste burial boxes. All of the plutonium-contaminated waste material from the two glovebox hoods was placed into six stainless steel boxes with identification letters A through F. Boxes A through E have 104.8- x 196.2- x 119.4-cm i.d.'s. Box F has an i.d. of 154.9 x 266.7 x 192.4 cm. The loaded boxes were assayed for plutonium content using both neutron and gamma-ray techniques. The difference between the results were greater than anticipated. Because of the importance of accurate plutonium assay measurements, additional measurements of box contents were made using a variety of techniques and assumptions including downloading of boxes and measurement of individual packages. These measurements have shown that a far-field, gamma-ray assay of a loaded waste box usually provides adequate measurement of low-density plutonium content, such as that found

in packages of plastic, cellulose, and clothing. Comparing the far-field assays of the loaded waste boxes to the quantities determined by the assays of the downloaded packages resulted in good agreement between the two methods for boxes with low attenuation. Based on these results, it was concluded that it was valid to use the far-field assay results for the boxes that were not downloaded.

51904 Applied safeguards when designing recovery processing facilities. Hawke, A.; Frank, M. *Transactions of the American Nuclear Society (USA),* 55: 21-22 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

The Rocky Flats Plant (RFP) is a part of the US Department of Energy (DOE) weapons complex under the direction of the Albuquerque office, which has responsibility for research, development, and production of nuclear weapons. The work performed at RFP includes machining, assembly, and inspection of plutonium parts. This work generates a variety of scrap and residues requiring separation and recovery of the contained plutonium. The plutonium recovery process at RFP uses pyrochemical and aqueous processing equipment to recover this material. The RFP is currently modifying and redesigning portions of the reprocessing facility. A basic strategy for the project will be the construction of modular components for the process systems that will allow construction in parallel with the facility modifications. The design concept will be responsive to the requirements governing the design and operations of plutonium process systems. Included are requirements for operations, safeguards nuclear material control and accountability, physical security, health and safety, environmental protection, quality assurance, and decontamination and disposal of existing process equipment. Because the design is modular, this concept will allow all disciplines to incorporate state-of-the-art designs that can be easily adapted as requirements change in the future. The paper addresses safeguards requirements and how they will be applied to the design.

51905 Plutonium NDA by thermal fluxmetry. Monier, J.; Sanson, C.; Bourrelly, P.; Patin, H.; Schoepp, R. *Transactions of the American Nuclear Society (USA),* 55: 24 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

Quantitative nondestructive assay (NDA) measurements of calorific materials by calorimetry often encounter, in the case of samples with a volume ≈1l or more, the difficulty of long measurement times. Nondestructive measurements at industrial production sites can sometimes be regarded as satisfactory, even with measurements that might carry a higher uncertainty, provided that the long measurement times can be significantly reduced. With this in mind, the authors have developed a spider-like thermal flux-meter for making quick nondestructive measurements of thermal powers up to 20 W for sample containers with a volume between 0.5 and 10l. The Fluxmeters developed are constructionally adapted to several different types of measurement features. The authors describe three types of fluxmeters that are suitable for rapid measurement times and have accuracies from 1 to a few percent for storage recesses or production facilities in the paper. Usually 5 to 8, and up to 25, fluxmeters are working simultaneously to reduce the mean measurement duration for a sample. The paper presents the results of an inventory control period involving the measurement of several hundred containers within 3 days by a three-man team.

51906 A nondestructive method based on gamma spectrometry for the measurements of plutonium hold-up or plutonium wastes. Morel, J.; Chauvenet, B.; Etcheverry, M.; Louppe, L.; Monier, J. *Transactions of the American Nuclear Society (USA),* 55: 25-26 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

With respect to in-plant holdup and wastes, plutonium quantities are measured in most cases by nondestructive methods such as neutron counting, gamma-photon counting, and infrared detection. These methods are often imperfect for various reasons: difficult access to sample, highly radioactive background, screens, etc. It is therefore of interest to develop other methods in order to check the results from these techniques or improve them. The quick method described is used for measuring the quantities of plutonium kept in various types of containers such as gloveboxes, cans, etc. It is applicable to the evaluation of sample masses ranging from a few tens of milligrams to several tens of grams. It is based on the gamma-ray spectrometry technique with germanium detectors. Gamma rays emitted by plutonium isotopes in the 100- to 500-keV energy range permit us, after a quick isotope composition determination, to obtain the plutonium total mass corrected for absorption and self-absorption by extrapolation to infinite energy of the apparent masses calculated for the energies of the selected peaks. This method has been used for several months in different fields such as the accountancy of the plutonium holdup in fuel fabrication plants; the reprocessing and the storage of radioactive wastes; and the supervision of the dismantlement.

51907 An emergency inventory system at the Oak Ridge Y-12 plant. Smith, S.E. (Oak Ridge National Lab., TN (USA)); Hall, C.P. *Transactions of the American Nuclear Society (USA),* 55: 26-27 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

One of the primary missions of the Oak Ridge Y-12 Plant is the production of nuclear weapons components. The production of these components dictates the handling of large quantities of highly enriched uranium and other nuclear materials. To help keep track of these materials, a computerized accounting system has been in operation since 1982. The system is called the dynamic special nuclear material control and accountability system (DYMCAS) and allows for the near-real-time tracking of special nuclear materials (SNM) in all the production areas of the plant. These numerous production areas are isolated into controlled material access areas (MAAs) for safeguards and security reasons. If, for some reason, the MAA boundary is breached without authorization or if an unusual circumstance arises in the area, the SNM contained inside each MBA in the MAA must be verified by an emergency inventory. With the current state of development base versatility, personal computers (PCs), and bar code technology, it was apparent that manual emergency inventory could be significantly improved. Therefore, the new emergency inventory system (EIS) was developed. The principle of the EIS is described in the paper.

51908 Evaluation of the neutron self-interrogation approach for assay of plutonium in high materials. Russo, P.A. (Los Alamos National Lab., NM (USA)); Menlove, H.O.; Fife, K.W.; West, M.H. *Transactions of the American Nuclear Society (USA),* 55: 27-28 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

The pyrochemical scrap recovery processes, designed to extract impurities from plutonium metal and compounds, generate a variety of plutonium-laden residues consisting of high (α,n) matrices of varying chemical composition, and often containing grams to tens of grams of americium. For such materials, multiplication corrections based on real neutron coincidence count rate, R, and total neutron count rate, T, measurements cannot be applied because of the large, unknown, and variable (α,n) component in the total neutron emission rate. A study of the prototype self-interrogation assay method is in progress at the Los Alamos plutonium facility. In the self-interrogation approach, the assay signature R(IF)/T is a function of effective fissile plutonium content, where R(IF) is the induced fission component of the measured reals rate, and T is the measured, (α,n)-dominated totals rate. The present study includes a calibration effort using standards consisting of mixtures of PuO_2 and PuF_4 in a salt-strip matrix. The neutron measurements of the standards and the process materials have been performed at the Los Alamos Plutonium Facility. The precision and accuracy of the self-interrogation method applied to pyrochemical residues is examined in this study.

51909 Recent advances in segmented gamma scanner analysis. Sprinkle, J.K. Jr. (Los Alamos National Lab., NM (USA)); Hsue, S.T. *Transactions of the American Nuclear Society (USA),* 55: 28-29 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

Segmented gamma scanning was developed by Los Alamos National Laboratory in the early 1970s to assay the special nuclear material (SNM) contained in low-density scrap and waste (such as

paper wipes, gloves, and plastic containers) by measuring the gamma emission rate. The instrument based on this procedure, the segmented gamma scanner (SGS), is widely used in the US Department of Energy complex and industry, and is manufactured by commercial vendors. Quantitative gamma assays nominally require the sample to be homogeneous; however, much of the scrap and waste is highly heterogeneous. In the SGS procedure, two methods have traditionally been employed to reduce the effects of the heterogeneity. To improve the vertical response, the sample is assayed segment by segment. To improve the horizontal response, the sample is rotated during the assay of each segment. A transmission measurement is made on each segment to correct for the sample attenuation of the assay signal by the low-Z matrix. This procedure is appropriate for samples of non-self-absorbing SNM distributed somewhat uniformly in a low-density matrix. Most of the scrap and waste found in facilities does not satisfy the nonabsorbing assumption. Therefore it is important to develop methods to identify the basis and flag the assay as suspect, and to develop analysis methods to correct for the bias. Two sources of bias have been identified, the end effect and lump effect. Corrections are discussed.

51910 Prototype fast neutron counter for the assay of impure plutonium. Wachter, J.R. (Los Alamos National Lab., NM (USA)); Adams, E.L.; Ensslin, N. *Transactions of the American Nuclear Society (USA),* 55: 30-32 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

For plutonium-bearing materials that undergo (α,n) reactions, such as oxides, metal with oxide coatings, salts, and residues, the present generation of thermal neutron coincidence counters often gives inaccurate assays. This is because thermal counters that measure only coincident and total neutrons do not uniquely specify the plutonium mass for samples with unknown self-multiplication and (α,n) reaction rates. Currently, a fast neutron counter using liquid scintillators and gamma-ray/neutron pulse-shape discrimination is being developed and evaluated for the nondestructive assay of impure plutonium materials. This type of counter can provide a direct solution to the measurement problems associated with impure plutonium by collecting single, double, and triple coincidence events. The goal of a fast neutron counter is to correctly determine the plutonium content of any sample without prior knowledge of its self-multiplication or (α,n) reaction rate. The present prototype meets this goal to within 3 to 5% RSD for many in-plant materials containing 10g ^{240}Pu or more.

51911 Use of process data to reach international safeguards conclusions. Lovett, J.E. *Transactions of the American Nuclear Society (USA),* 55: 34 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

The International Atomic Energy Agency's (IAEA's) current detection capability for plutonium in reprocessing plants is 3.3% of throughput. For plutonium in mixed-oxide fabrication plants it is 1.65%, and for low-enriched uranium fabrication it is 1.0% of throughput. It was recognized over a decade ago that these percentage values could be disturbingly large for larger throughput plants, and considerable effort has gone into a search for more effective safeguards measures. Near-real-time materials accountancy, penetration monitoring, and process monitoring are three concepts that have been studied with particular emphasis. Each of these concepts has its unique advantages and disadvantages. It is not difficult to show that each of the concepts is capable of providing a significant increase in detection sensitivity, if one first agrees that detection of an anomaly that could be indicative of diversion is all that is required. If one insists on an objective and quantifiable decision that the probable explanation of the anomaly is that diversion has occurred, then all three concepts founder, either because rational alternative explanations can be identified or because practical investigation procedures to determine the cause of the observed anomalies cannot be defined.

51912 The use of safeguards data for process purposes. Barnes, J.W. (Los Alamos National Lab., NM (USA)). *Transactions of the American Nuclear Society (USA),* 55: 34-35 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

Nuclear materials accounting is an important part of nuclear fuel cycle operations. It provides assurance that nuclear material is present and at its proper location. The materials accounting system can also provide information that is useful to operations. A modern materials control and accounting (MC & A) system can monitor equipment performance, holdup accumulation, and operational safety. A modern MC & A operation can provide information on process systems where measurements do not exist or are impractical. The operational benefits of an integrated process control/near-real-time materials accounting system are many. Computerized MC & A systems available in modern process plants allow closure of material balances on individual material movements or process operations. Frequent closures on sub-materials balance areas or individual process vessels localize and identify process problems in a timely manner. The MC & A system has been used to monitor process equipment performance and detect the unplanned loss of material when the normal process control systems were incapable of detecting problems.

51913 Safeguarding a reprocessing plant with the method of cumulated flux. Delange, M. *Transactions of the American Nuclear Society (USA),* 55: 35 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

The basic principles of international safeguards and the roles of accountancy verifications and surveillance measures, especially in large bulk-handling facilities, are recalled. An approach for safeguarding large industrial reprocessing plants can be based on procedures that have been progressively developed since 1966 in the UP2 plant, where 1800 tonnes of light water reactor fuels have been reprocessed since 1976. This approach is now routinely used for management purposes. Such a reprocessing plant is essentially composed of three material balance areas (MBAs): (1) storage of irradiated fuel, (2) process area, and (3) product storage. For the process area MBA, the suggested approach is based on a combination of real-time accountancy verification of all inputs and outputs, and permanent assessment of the cumulated flux of inputs and outputs. This permanent assessment enables international inspectors to know the amount of nuclear material that is declared as being under process daily, and to compare it with the quantity that is supposed to be under process, according to the design information of the plant.

51914 Present status of safeguards implementation in PNC from a statistical standpoint. Tomikawa, H.; Hirai, K.; Kajiyoshi, M.; Nakano, H. *Transactions of the American Nuclear Society (USA),* 55: 36-37 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

Japan ratified the Non-Proliferation Treaty (NPT) in 1976. According to the provisions of Articles III.1 and III.4 of the NPT, the Safeguards Agreement between the government of Japan and the International Atomic Energy Agency was concluded in 1976. Power Reactor and Nuclear Fuel Development Corporation (PNC) is engaged in the development of all areas of nuclear fuel cycle technology as well as in the development of fast breeder reactor and heavy water reactor technology. Many PNC facilities, such as plutonium-handling facilities and a uranium enrichment facility, are significant facilities for safeguards implementation. The present status of safeguards implementation at PNC is based on data collected over the last few years.

51915 Near-real-time materials accountancy: Use of SITMUF and page's test to detect losses occurring in a complex pattern. Jones, B.J. *Transactions of the American Nuclear Society (USA),* 55: 38 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

It is probably accepted that near-real-time materials accountancy (NRTMA) can lead to a more timely detection of losses. However, there may be some concern that this timeliness can be gained only at the expense of a power reduction to ultimately detect a loss of a given size. It has been demonstrated the NRTMA, using the standardized independent transformed material unaccounted for (MUF) SITMUF values and Page's test, is superior to conventional accountancy in three ways. Further aspects of the performance of NRTMA

using Page's test are investigated. Reference 1 did not consider the case of protracted losses occurring at a variable rate or in an intermittent fashion. Both of these aspects are considered. Another factor that might be expected to affect the behavior of Page's test, namely, the frequency with which balances are taken, is studied. These investigations were all carried out using data from a model with characteristics similar to those expected at the new British Nuclear Fuels Thermal Oxide Reprocessing Plant.

51916 Hanford chemical processing accountability system upgrade. Keck, R.D.; McRae, L.P. *Transactions of the American Nuclear Society (USA),* 55: 39-40 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

Accounting and control of nuclear material is required for two chemical processing plants in the 200 areas of the Hanford site located in southeastern Washington. Irradiated nuclear fuel is reprocessed in the Plutonium Uranium Extraction (PUREX) Plant. The second plant, the Plutonium Finishing Plant (PFP), recovers plutonium from scrap and converts plutonium from a liquid to a solid form. The basic requirement for an upgraded nuclear material accountability system will be to improve system response and to reduce the labor intensity by on-floor entry of accounting data by process operators at the point of data origin. The existing accounting system in the 200 areas will be replaced in a three-phase process. In the first phase, new accountability systems will be installed in the PFP and the PUREX plant. In the second phase, an automated system for tracking moments of nuclear material items within the plants would be added. The third phase would interface the accountability system to the processes in the plants to obtain near-real-time process material balances.

51917 The Idaho chemical processing plant process monitoring computer system. Dahl, C.A.; Liester, N.A. *Transactions of the American Nuclear Society (USA),* 55: 40-41 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

The process monitoring computer system (PMCS) at the Idaho Chemical Processing Plant (ICPP) is a set of data acquisition devices that transmit data from the plant instrumentation and specialty devices installed on the plant equipment to a computer for data processing and storage. The system is used by both the safeguards and operations staffs to help assure the controlled operation of the facility through on-line analysis of process data in a quick and convenient manner. The PMCS has demonstrated that the goals of safeguards and production may be combined into one overall process system, thus assuring a higher degree of process efficiency and surety of mutually desirable goals.

51918 Recent progress in the testing and implementation of measurement equipment for safeguards applications. Schenkel, R. *Transactions of the American Nuclear Society (USA),* 55: 42 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

The Euratom Safeguards Directorate has made a considerable effort during the last few years on the acquisition, testing, calibration, and implementation of new safeguards equipment. This reflects the importance that Euratom places on the role of containment and surveillance and of measurement equipment in safeguards implementation. The following are among the equipment used and tested. 1. Gamma equipment: Silena Cicero, Davidson MCA, enrichment meter, plutonium meter, X-ray K-edge densitometer, and portable K-edge densitometer. 2. Neutron equipment: high level neutron coincidence counter, family of equipment including the neutron coincidence collar, the active well coincidence counter, the universal fast breeder reactor counter, and the inventory sample coincidence counter. In addition, experience and results have been obtained with SIGMA (on-line instrument to determine ^{235}U in fuel pebbles), Phonid (^{235}U determination with photoneutron technique), and the CIND (Controleur Isotopique Non Destructif for ^{235}U determination in UF_6 cylinders). 3. Other measurement equipment: For the various other equipment available, procedures include spent-fuel measurement with the ION-1 FORK, use of load cell equipment in various installations for various applications, and the in-field inspection use of two portable mass spectrometers for the measurement of UF_6 and UO_2 samples.

51919 Transmission-corrected x-ray fluorescence analysis of uranium and plutonium solutions using a dual transmission source. Ruhter, W.D. (Lawrence Livermore National Lab., CA (USA)); Camp, D.C. *Transactions of the American Nuclear Society (USA),* 55: 46-47 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

Energy-dispersive X-ray fluorescence analysis (XRFA) is a technique that has been implemented at spent nuclear fuel reprocessing facilities for nondestructive measurement of uranium and/or plutonium concentrations in process streams. In XRFA, atoms of interest within a sample are fluoresced, and from the detected intensities of the atoms' characteristic X rays, the concentrations of the fluoresced atoms can be determined. The authors used 122-keV gamma rays from collimated ^{57}Co sources to optimally fluoresce uranium or plutonium atoms in solutions. A portion of the stimulated K X rays are detected by a collimated high-purity germanium (HPGe) detector. A common difficulty with X-ray fluorescence analysis of solutions is attenuation of the fluoresced X rays by the solution, which makes the X-ray intensities not directly proportional to the concentration of the atoms being measured. The current calibration procedure used to determine this nonlinear relationship for uranium/plutonium solutions requires at least six solution standards containing uranium/plutonium concentrations that span the range of interest and are chemically similar to the solutions to be measured. The calibration curve is representative only of the uranium/plutonium and acid concentrations of the standards used. To reduce the sensitivity of XRFA to variations in the solution matrix, a method has been developed to accurately correct the X-ray intensities for sample self-attenuation by measuring transmissions through the solution at two different energies.

51920 Sources of measurement error in plutonium solids isotopic assay measurements. Fleissner, J.G. *Transactions of the American Nuclear Society (USA),* 55: 47 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

Nondestructive assay (NDA) measurements for safeguards purposes have enjoyed a wide acceptance in recent years due largely to the significant technological advances in NDA instrumentation and measurement techniques. However, these technological advances have made apparent the limitations of these instruments when applied to the assay of many real world material types. These limitations (such as heterogeneity and lack of appropriate standards) arise from the very nondestructive nature of the measurement itself and can lead to sources of error in the measurement process. Thus, one area in need of improvement in the NDA field is the recognition and understanding of these sources of measurement error. In the past, attempts have been made to bias correct for sources of measurement error. With the current generation of NDA instrumentation, the biasing effects can often be either totally eliminated or reduced to their lowest practical level by understanding the sources of measurement error. This will permit corresponding decreases in inventory differences and shipper-receiver differences.

51921 A comparison of conventional and prototype nondestructive measurements on molten salt extraction residues. Longmire, V.L. (Los Alamos National Lab., NM (USA)); Scarborough, A.M. *Transactions of the American Nuclear Society (USA),* 55: 47-48 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

Impure plutonium metal is routinely processed by molten salt extraction (MSE) to reduce the amount of americium in the metal product. Individuals form four technical groups at the Los Alamos National Laboratory (LANL) participated in a study designed to evaluate the accuracy of various nondestructive assay (NDA) techniques for measuring the plutonium content in MSE residues. This study was performed to improve in-house accountability of these items and to identify assay methods that would be acceptable for determining receiver's values for MSE salts from off-site sources. Recent upgrades have been made in a segmented gamma scan system, in a thermal neutron coincidence counter, and in the software of a gamma isotopic system that supports the calorimeters at

LAPF. The authors evaluated the newer systems against the older systems versus destructive qualitative analyses. Fourteen containers of MSE residues were selected to be studied. Seven of these salts originated at LAPF and seven originated at Rockwell International Rocky Flats plant. Measurements have been performed on these items in their original containers, and the items have been repackaged into a different geometry and assayed again.

51922 Active and passive NDA methods for nuclear materials. Bernard, P.; Berne, R.; Bosser, R.; Cloue, J.; LePeron, A.; Pinel, J.; Romeyer-Dherbey, J. *Transactions of the American Nuclear Society (USA),* 55: 48 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

Recent developments at Commissariat a l'Energie Atomique, Cadarache, France, use active and passive nondestructive assay (NDA) measurement methods for nuclear material control. These NDA measurement methods concern the measurement and analysis of fuel assemblies, fissile material concentration in solutions or depositions, residual fuel and fissile materials in hulls, and solid form materials (wastes or nuclear materials). The methods use a combination of passive detection and subsequent analysis of the gamma rays and neutrons emitted by the materials to be controlled, and an active method, i.e., inducing fission in fissile material using an external mobile neutron source followed by the detection of delayed neutron and/or gamma rays.

51923 NDA for a new facility at SRP. Studley, R.V. *Transactions of the American Nuclear Society (USA),* 55: 48-51 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

In 1980, plans were initiated to build a new facility to process high purity highly enriched ^{235}U. Interest in improving nuclear safeguards had been increasing in the previous few years. A basic objective of the design, therefore, included achievement of maximum performance in special nuclear material (SNM) accountability. A near-real-time accountability system with high accuracy assay measurements was developed for this purpose. Simultaneous design of facility, process equipment, and the accountability system allowed maximum integration of equipment and also permitted influence on process design and material characteristics to optimize accountability performance. This was an ideal situation in which to pursue maximum improvement in nondestructive assay (NDA) measurement performance. The resulting systems are described.

51924 Assay of fissile materials using a combined thermal/epithermal neutron interrogation technique. Coop, K.L. (Los Alamos National Lab., NM (USA)); Caldwell, J.T.; Goulding, C.A. *Transactions of the American Nuclear Society (USA),* 55: 51-52 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

The authors have developed and built a prototype device to assay fissile materials using a technique that interrogates samples with both thermal and epithermal neutrons. The technique is based on that used in the lead slowing down spectrometer. However, the device is much smaller and less expensive, with poorer energy resolution than a true lead slowing down spectrometer. It is believed that this development may be uniquely suited for the very difficult problem of determining the fissile content in nuclear waste derived from irradiated breeder reactor fuel rods. The waste is of highly variable composition, ranging from absorbed solutions to discrete Pieces several grams in size, embedded in different matrices. The nuclear material is mixed uranium/plutonium fuel of variable enrichment and burnup. While this device was developed specifically to assay remote handled waste, it may be of value for other safeguards applications. One problem in particular for which it may be useful is determining whether enriched uranium is being concealed with lead and cadmium shielding in a box or package.

51925 Can containment and surveillance play a more important role in safeguards?. Cuypers, M.; Haas, R. *Transactions of the American Nuclear Society (USA),* 55: 53 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

The implementation of safeguards by international inspectors presently relies, in an important way, on the independent assay of nuclear materials by destructive and nondestructive analysis (NDA) techniques. Significant experience has been gained in the application of those techniques on a variety of nuclear materials and for different parts of the fuel cycle. The basis for the evaluation of capabilities and performances of destructive analysis and NDA applied in field conditions exists and is now being exploited extensively. In the field of containment and surveillance (C/S), the degree of maturity for implementation is rather different. After a long development period, a good level of reliability and tamper resistance has been reached for a limited number of devices, which appear to be acceptable for implementation in safeguards in combination with assay techniques. The usefulness of these techniques to the inspectors and the impact of their use on plant operation needs to be assessed before further steps are taken to reach production of C/S devices on an industrial scale. Two conditions that will probably enhance the deployment of C/S are the increased radiation hazard and the high degree of automation of storage and process lines, which will lead to a much lower degree of accessibility to the nuclear material for direct assay.

51926 In situ automatic verification kit for optical seals. Monier, J.; Maurel, J.; Carratt, M.; Hakoun, R. *Transactions of the American Nuclear Society (USA),* 55: 53-54 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

The Commissariat a l'Energie Atomique (CEA)/CLTO seal system consists of a square molded optical waveguide including the two ends of an optical fiber loop. Identification and control are performed by a high resolution portable charge-coupled device camera and a personal computer. These CEA/CLTO optical seals, which have been implemented in several storage containers (i.e., plutonium bird cages) by inspectors in domestic control in France, and it is expected that they will be used extensively in the future.

51927 Safeguards experience in the timely and unequivocable detection if irradiated fuel transfer in CANDU reactors. Keddar, A. *Transactions of the American Nuclear Society (USA),* 55: 54-55 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

The International Atomic Energy Agency (IAEA) is continuously improving methods and techniques to verify nuclear material for safeguards purposes. Among the tasks to be implemented was the detection of irradiated fuel bundles as soon as they are discharged from Canadian deuterium-uranium (CANDU) reactors. The CANDU reactors are continuously refueled, and spent fuel from such reactors is discharged from the reactor by fueling machines to the fuel discharge or receiving bay via spent fuel discharge ports. An instrument called the spent-fuel bundle counter has been designed, constructed, and installed in most of the CANDU reactors to monitor each discharge port and to detect, count, and record the number of fuel bundles that are discharged. In some cases, bundles are returned form the storage bay to the reactor, and for safeguards purposes they should also be detected, counted, and recorded. The combination of inspection with unattended surveillance and fuel bundle accountancy allows the detection and deterrence of spent fuel diversion.

51928 A DOE/DP multisite approach to safeguards integration with facility operations. Ostenak, C.A. (Los Alamos National Lab., NM (USA)). *Transactions of the American Nuclear Society (USA),* 55: 57 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

The Accountability Technology Exchange (ATEX) Working Group was established in October 1986 by the plutonium processing technology exchange steering committee under the US Department of Energy/Department of Defense program's materials management executive committee (DOE/DP MMEC). The ATEX Working Group provides a multisite, multidisciplinary forum for discussing, evaluating, and recommending both existing and emerging nuclear materials accountability measurement technologies for implementation into DOE/DP plutonium processing facilities. This forum assists technologists in understanding state-of-the-art plutonium processing

and accountability measurement practices throughout the complex, as well as current and projected technical needs. As a result, the ATEX Working Group will contribute to the improvement of plutonium processing technologies by helping to assure that the best possible nuclear materials accountability measurement techniques are made available to all sites to process plutonium safely, securely, and cost-effectively.

51929 Development of a generic computerized nuclear material accountability system. Cornell, M.D.; O'Leary, J.M.; McCutcheon, S.H. *Transactions of the American Nuclear Society (USA),* 55: 57-58 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

A computerized nuclear material accountability system (NucMAS) has been developed jointly by DuPont at Savannah River Plant (SRP) and Los Alamos National Laboratory (LANL). The SRP is faced with the goal of improving the accuracy and timeliness of nuclear material accountability. Limited manpower, funding, and time led to the decision to develop a single, generic, process-independent computer system for use throughout SRP's separations facilities, rather than traditional process-specific accountability computer systems. The NucMAS system is currently being installed in each of the material balance areas (MBAs) within SRP's separations facilities. It services the basic need for management of nuclear material inventory data to support timely, accurate, and consistent accountability reporting. Data input for NucMAS can come from any combination of manual entries and automated input, such as distributed control systems, laboratory computers, and vault surveillance systems. The system can be operated as a traditional, after-the-fact accountability system or in a near-real-time mode in situations where more timely data input is available and material control functions are desired. The granularity at which the accounting is performed is set by the MBA custodian and the level of detail at which input information is available.

51930 Material accountancy system at a new automated mixed-oxide facility: PFPF. Ohtani, T.; Seya, M.; Takahashi, S.; Asakura, K.; Kikuchi, M. *Transactions of the American Nuclear Society (USA),* 55: 58-59 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

At conventional mixed-oxide (MOX) fuel fabrication facilities, the personal radiation exposure of operators increases in proportion to the amount of plutonium to be handled. To resolve this issue, automated techniques in high-level radiation areas have been introduced at Japan's new MOX facility, the plutonium fuel production facility (PFPF). The PFPF incorporates a fully automated operating scheme into the main process and storage areas. Unlike conventional MOX fuel fabrication facilities, operators do not need direct access to nuclear material during normal plant operation. To achieve process control including criticality safety, PFPF has introduced an on-line computerized advanced accountancy system (AAS), which is capable of obtaining all inventory information throughout the entire facility in detail. The AAS can acquire material accounting data from equipment installed in each storage unit. All materials in the process areas are itemized as each transfer container is moved, and each container is measured at internal measurement points between a glovebox and any intermediate storage unit. The AAS can acquire material accounting data from information on the amount of nuclear material transferred. Thus, all material accounting data are obtained automatically by management on a real-time basis.

51931 International safeguards at the Dounreay fast reactor reprocessing plant. Jones, T.L. *Transactions of the American Nuclear Society (USA),* 55: 60 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

International safeguards have been applied to the fast reactor reprocessing plant at Dounreay since October 1981. From October 1981 until October 1982, this was done by the International Atomic Energy Agency (IAEA) and Euratom under the terms of a tripartite treaty between the parties and a voluntary offer made by the United Kingdom, a weapons state, to the IAEA. Since October 1982, on-site safeguards have been applied by Euratom alone, with all periodic reports being passed on to the IAEA by Euratom. International safeguards are applied to the plant using a combination of nuclear materials accountancy, containment and surveillance techniques (C/S), and a daily inspector presence while the plant is in operation. For the purpose of nuclear materials accountancy, the plant is divided into two material balance areas. The C/X measures involve the use of seals and cameras. The plant is also used for the development of safeguarding techniques for application to future reprocessing plants. Work is currently being undertaken in support of near-real-time nuclear materials accountancy, the verification of analyses carried out by the operator, the on-line application of K-edge absorptiometry, and the use of weighing techniques to measure the quantity of nuclear material in an accountancy tank.

51932 Analysis of a nuclear material accountancy exercise carried out on mixed-oxide fuel fabrication at Windscale Nuclear Laboratories. Snape, G.P.; Davis, E.H. *Transactions of the American Nuclear Society (USA),* 55: 60-61 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

The $(U,Pu)O_2$ fuel manufacturing laboratory at Windscale Nuclear Laboratories manufactures mixed-oxide (MOX) experimental fast reactor fuel. The object of nuclear material accountancy (NMA) is to monitor the input, output and inventory of fissile material within our accounting areas (material balance areas). Any discrepancy between the book values of stock and the measured values is referred to as inventory difference (ID), sometimes described as material unaccounted for. It is important to be able to quantify the errors associated with ID so that it can be established whether the quoted figures are acceptable. For this reason it was decided, with full cooperation between fissile material control staff and operators, that a suitable MOX manufacturing campaign would be examined in some detail to compare the measured errors in NMA with those expected and to identify areas in which the accuracy could be improved. The NMA computer program SMART had been in operation during the year previous to the exercise, so it proved convenient to confirm in detail that procedures were satisfactory. An analysis of the errors involved in the weighing of material, chemical assay of plutonium content, and assessment of the plutonium content of sweepings, residues, and plutonium-contaminated material gave an overall estimate of +13.1 g plutonium or 0.1% of throughput.

51933 Special nuclear material inventory sampling plans. Vaccaro, H. (Los Alamos National Lab., NM (USA)); Goldman, A. *Transactions of the American Nuclear Society (USA),* 55: 61-62 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

Since their introduction in 1942, sampling inspection procedures have been common quality assurance practice. The U.S. Department of Energy (DOE) supports such sampling of special nuclear materials inventories. The DOE Order 5630.7 states, Operations Offices may develop and use statistically valid sampling plans appropriate for their site-specific needs. The benefits for nuclear facilities operations include reduced worker exposure and reduced work load. Improved procedures have been developed for obtaining statistically valid sampling plans that maximize these benefits. The double sampling concept is described and the resulting sample sizes for double sample plans are compared with other plans. An algorithm is given for finding optimal double sampling plans that assist in choosing the appropriate detection and false alarm probabilities for various sampling plans.

51934 System analysis for material control and accountancy technology. Persiani, P.J. (Argonne National Lab., IL (USA)); Daly, T.A.; Bucher, R.G.; Rothman, A.B.; Cha, B.C.; Trevorrow, L.E.; Seefeldt, W.B. *Transactions of the American Nuclear Society (USA),* 55: 62-63 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

The systems analysis for material control and accountancy technology (SAMCAT) program involves a working group structured to ensure that direct operating measurements, accountancy experience, and knowledge of the processes and flows of nuclear material in the total US Department of Energy (DOE) complex of production

fuel cycles would be the major bases for developing and implementing a plan of action. This working group consists of facility operators, DOE Office of Safeguards Security headquarters and field offices, and government laboratories. The program focus is to develop a system for decision support in validating the material control and accountancy (MC&A) aspects of the masters safeguards and security agreements effectiveness and in evaluating proposed MC&A upgrades. This paper is a status report on the current capabilities of the system.

51935 **Notes on the MUF-D statistic.** Picard, R.R. (Los Alamos National Lab., NM (USA)). *Transactions of the American Nuclear Society (USA),* 55: 64-65 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

Verification of an inventory or of a reported material unaccounted for (MUF) calls for the remeasurement of a sample of items by an inspector followed by comparison of the inspector's data to the facility's reported values. Such comparison is intended to protect against falsification of accounting data that could conceal material loss. In the international arena, the observed discrepancies between the inspector's data and the reported data are quantified using the D statistic. If data have been falsified by the facility, the standard deviations of the D and MUF-D statistics are inflated owing to the sampling distribution. Moreover, under certain conditions the distributions of those statistics can depart markedly from normality, complicating evaluation of an inspection plan's performance. Detection probabilities estimated using standard deviations appropriate for the no-falsification case in conjunction with assumed normality can be far too optimistic. Under very general conditions regarding the facility's and/or the inspector's measurement error procedures and the inspector's sampling regime, the variance of the MUF-D statistic can be broken into three components. The inspection's sensitivity against various falsification scenarios can be traced to one or more of these components. Obvious implications exist for the planning of effective inspections, particularly in the area of resource optimization.

51936 **Safeguards effectiveness evaluations in safeguards planning.** Al-Ayat, R.A. (Lawrence Livermore National Lab., CA (USA)). *Transactions of the American Nuclear Society (USA),* 55: 65-66 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

Safeguards effectiveness evaluation techniques play an important role in safeguards planning. Several systematic and quantitative methods have been developed for evaluating the effectiveness of existing safeguards and proposed modifications. At this time, the most widely used tool for insider threats is the safeguards evaluation tool (ET). A similar tool was developed by Sandia National Laboratories for identifying vulnerabilities against terrorist attack. This tool is known as SAVI (systematic analysis of vulnerability to intrusion). Also developed was MI&ER, a method to integrate the results of an insider and outsider threat evaluation, to allow comparison of benefits of various upgrades, and to identify those upgrade packages that achieve the greatest improvements in protection for a given cost. The MI&ER also provides a priority ranking among the cost-effective packages, thus allowing a decision-maker to decide which upgrades to implement and the amount of residual risk.

51937 **Item and personnel tracking.** Waddoups, I.G. *Transactions of the American Nuclear Society (USA),* 55: 66-67 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

Recently, efforts have been made to develop and demonstrate methods to utilize item and personnel tracking to provide additional protection against a potential insider threat. Technological methods are being evaluated to supplement clearances, human reliability programs, and other administrative techniques. Emphasis is being placed on currently available technology to allow rapid implementation as well as to identify areas in which development is needed. The demonstrations are done in operating facilities to assess the degree of impact various approaches have on facility operations as well as to identify critical operations interfaces. Experience shows that present technology is effective and economical, but more accurate personnel tracking and better in-process material monitoring are needed.

51938 **Evaluating late detection capability against diverse insider adversaries.** Sicherman, A. (Lawrence Livermore National Lab., CA (USA)). *Transactions of the American Nuclear Society (USA),* 55: 66-67 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

The threat of theft or diversion of special nuclear material (SNM) by insiders is a key concern for safeguards planners. Different types of employees having varying degrees of access to both SNM and safeguards systems pose a difficult challenge for theft detection. Safeguards planners rely on physical security, material control, and accountability to provide detection of a theft attempt. When detection occurs too late to prevent a theft, it is called a late detection or late alarm. Activities or events that many provide late detection usually belong to material control and accountability (MC&A) activities. A model has been developed for evaluating the probability of late detection as a function of time elapsed since the theft. Late detection capability is beneficial if it is timely enough to improve the ability to determine the cause of an alarm, speed recovery of SNM, prevent an incorrect response to a threat demand, or promote assurance that no theft has occurred in the absence of an alarm. The model provides insight into the effectiveness of late detection safeguards components in place and helps to identify areas where the MC&A can be most effectively improved.

51939 **Fuel cycle oriented approach.** Petit, A. *Transactions of the American Nuclear Society (USA),* 55: 69 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

The term fuel cycle oriented approach is currently used to designate two quite different things: the attempt to consider all or part of a national fuel cycle as one material balance area (MBA) or to consider individual MBAs existing in a state while designing a unique safeguards approach for each and applying the principle of nondiscrimination to fuel cycles as a whole, rather than to individual facilities. The merits of such an approach are acceptability by the industry and comparison with the contemplated establishment of long-term criteria. The following points concern the acceptability by the industry: (1) The main interest of the industry is to keep an open international market and therefore, to have effective and efficient safeguards. (2) The main concerns of the industry regarding international safeguards are economic burden, intrusiveness, and discrimination. Answers to these legitimate concerns, which retain the benefits of a fuel cycle oriented approach, are needed. More specifically, the problem of reimbursing the operator the costs that he has incurred for the safeguards must be considered.

51940 **Implementation of a natural uranium fuel cycle safeguards approach in Canada.** Wredberg, L.; Thiele, R. *Transactions of the American Nuclear Society (USA),* 55: 71 (1987). (CONF-871110--: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

There are currently ten facilities in Canada that manufacture or use natural uranium fuel: one conversion plant, three fabrication plants, and six reactor facilities with 19 reactor units. Inspections during the material balance period between the annual physical inventories take place every second month for the conversion plant, every third month for the three fabrication plants, and every month for the reactor facilities. For the latter, containment and surveillance measures are used to a considerable extent. Studies are being made by the IAEA of the potential advantages of developing the present safeguards approach for the natural uranium fuel cycle into a so-called zone approach. The basis for such an approach is simultaneous physical inventory verifications of all facilities within the zone, which is already implemented in Canada. For the further implementation of a zone approach it would be necessary also to verify receipts into and shipments out of the zone; verify by quantitative methods the material in item form (i.e., fuel bundles); treat the zone as one material balance area with respect to the evaluation of the verification data; and to report the evaluation result in one concluding statement.

51941 Fuel cycle safeguards and optimization of inspection effort. Lovett, J.E. *Transactions of the American Nuclear Society (USA),* 55: 72 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

Various papers in recent years have compared safeguards for an entire state or for a major group of facilities in a state, termed fuel cycle oriented safeguards, with current facility-oriented safeguards approaches, usually with the implicit assumption that fuel cycle safeguards would somehow be more effective, or would require significantly less effort, if they could be achieved. Other papers have examined the question of the optimization of International Atomic Energy Agency (IEAE) safeguards, usually under the assumption that inspection resources were insufficient to achieve the desired degree of effectiveness but occasionally under the assumption that a predefined effectiveness was to be achieved using an optimum set of procedures and the minimum inspection resources. These two subjects are, in fact, different perspectives of the same subject. The uncertainty in a statewide material balance, if the IAEA could verify the entire nuclear material inventory in a state at one time, would be essentially identical to an uncertainty based on a Gaussian sum that included the uncertainties in facility material balances prepared under current procedures and the uncertainties associated with shipper/receiver differences between facilities within the fuel cycle considered.

51942 Safeguards implementation at US facilities during 1986 and 1987. Wredberg, L. *Transactions of the American Nuclear Society (USA),* 55: 73 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

Safeguards procedures were implemented at three nuclear facilities in the United States during 1986 and 1987, namely, the Westinghouse fuel fabrication plant in Columbia, South Carolina; the Salem No. 1 light water reactor (LWR) in New Jersey; and the Turkey Point No. 4 LWR in Florida. These three facilities have been under International Atomic Energy Agency (IAEA) safeguards since early 1986 in accordance with the voluntary offer agreement between the IAEA and the United States, which went into force in 1980. Because of limited manpower and budget resources allocated to safeguards in nuclear weapon states, only a limited number of facilities can be under IAEA safeguards inspections at a time. Facilities are, therefore, subject to inspection only during a 2-yr period in the case of the United States. After that period other facilities are selected for another 2-yr period from the list of facilities subject to safeguards under the agreement. The facilities have been selected so that they form a fuel cycle, i.e., the inspected reactors are fueled with fuel assemblies manufactured by the inspected fabrication plant. The IAEA applies full scope safeguards at the selected facilities based upon established implementation practice for the facility types.

51943 Automating special nuclear materials tracking. Pareto, V. *Transactions of the American Nuclear Society (USA),* 56: 100 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

In order to help control the threat of nuclear proliferation, the US Department of Energy (DOE) and the US Nuclear Regulatory Commission (NRC) have developed a system to track special nuclear materials (SNM). This system allows the government to know exactly how much SNM is located in any one licensed facility in the United States. The system described in this paper is the first computer program to fully automate the entire tracking process. The program, called Mtrac, prints facsimiles of all required NRC accountability reports such as the DOE/NRC 741, 742, 742C, and RW-859 in a form that meets all current accountability requirements. Mtrac can perform a complete core refueling in a way that is almost transparent to the user, it can allocate track country control codes, and it is designed to handle assembly consolidation and reconstitution. Although the system was originally designed for commercial light water reactors, the program can be adapted to track SNM in any licensed facility.

51944 Recent experience measuring breeder fresh fuel assemblies. Rizhikov, V.; Fager, J.; Menlove, H.O. *Transactions of the American Nuclear Society (USA),* 55: 422-43 (1987). (CONF-871110–: 3. international conference on facility operations safeguards interface, San Diego, CA (USA), 29 Nov - 4 dec 1987).

The International Atomic Energy Agency (IAEA) is required to conduct independent on-site verification of nuclear material held under safeguards agreements with member states. The nuclear material contained in liquid-metal fast breeder reactor (LMFBR) fresh fuel assemblies presents unique safeguards and measurement problems. Since LMFBR fresh fuel may contain uranium of various enrichments, plutonium, or mixtures of uranium and plutonium, a combination of nondestructive assay (NDA) methods and equipment must be used to achieve independent verification of the nuclear material contained in LMFBR fresh fuel assemblies. During 1985 and 1986, a number of measurements were carried out at the BOR-60 LMFBR facility near Dimitrovgrad, USSR to train IAEA inspectors in the use of standard NDA equipment and measurement procedures that can be employed to verify the nuclear material content of LMFBR fresh fuel. Since these measurements were conducted at an operation LMFBR facility, agency inspectors had an opportunity to receive training under actual field conditions. These activities also presented the first opportunity for the agency to test NDA measurement methods on LMFBR fresh fuel of the BOR-60 design. The measurements conducted at the BOR-60 site established that standard agency NDA equipment and procedures can be employed to independently verify the nuclear material content of LMFBR fresh fuel assemblies.

0560 Legislation and Regulations

Refer also to citation(s) 51742, 51757

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0702 Radiation Sources

Refer also to citation(s) 52979, 53437

51945 (JAERI-M–89-053) **Study on saccharification of cellulosic wastes with bench scale test plant, (5). Continuous saccharification of chaff.** Kasai, Noboru; Tamada, Masao; Kumakura, Minoru. Japan Atomic Energy Research Inst., Tokyo (Japan). May 1989. 19p. (In Japanese). Order Number DE90710046. Available from NTIS (US Sales Only), PC A03/MF A01.

This report completed the results that were obtained on the studies of continuous saccharification of radiation pretreated chaff with a saccharification equipment unit of bench scale test plant for cellulosic wastes. The problem on the continuous saccharification in bench scale and its countermeasure were clarified. The glucose concentration obtained in the continuous saccharification was examined from the point of a scale up effect. It was found that there are not a scale up effect between flask scale (100 ml) and bench scale (50 l) and then the same concentration of glucose was obtained in both scales. It was clarified that the contamination of the process let decrease markedly the concentration of produced glucose solution and brings on a large trouble for the saccharification. The addition of 1 % ethyl acetate made it possible to prevent the contamination of the saccharification process in flask scale. However, in the case of continuous saccharification in bench scale, the addition of ethyl acetate in nitrogen gas atmosphere was necessary to prevent the contamination. It was found that the solution of 1.7 % glucose concentration was continuously produced in the continuous saccharification with the most longest period for 26 days. It was, also, suggested that the selection of a suitable retention time is necessary to attain a high glucose productivity in the continuous saccharification. (author).

51946 (LA-UR–89-2920, pp. 12, Paper 5) **Status report of SINQ: A continuous spallation neutron source.** Fischer, W.E. (Paul Scherrer Institute, Villigen (Switzerland)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM

(USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

A most significant development at SIN the past year has been the merging of several research institutes to what is called the Paul Scherrer Institute (PSI). The new institute contains the former Swiss Institute for Nuclear Research (SIN), Federal Institute for Reactor Research (EIR), and Radio Corp. of America Laboratory in Zurich (RCA). Research departments at PSI are Nuclear and Particle Physics; Biological and Medical Science; Physics of Condensed Matter, Material Science; and Energy Research and Engineering Sciences. One of the tasks of the institute is the development and operation of complex research facilities. The institutes' accelerator system (formerly SIN) is the backbone for the research programs. The accelerator system delivers today a proton beam of 200-250 microA at 590 MeV onto meson targets. Improvements in beam currents are scheduled. The design for the spallation-neutron source is discussed. Also discussed are the spectrometers planned to be installed at the spallation source. 9 figs., 1 tab.

51947 (LA-UR–89-2920, pp. 12, Paper 6) **The ISIS target.** Carne, A. (Rutherford-Appleton Laboratory, Oxon (England)); Broome, T.A.; Hogston, J.R.; Holding, M. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

This presentation discusses the two target failures that have occurred, gives the understanding of the causes and indicates the steps being taken to alleviate the problems. At the outset of the design it was understood that the target would have a finite lifetime, due to radiation damage effects, exacerbated by mechanical damage due to thermal cycling and fatigue. Estimates of target lifetime at full intensity are about 2 years for radiation damage swelling and about 10E4 gross thermal excursions. The latter number is the one which gives uncertainty in defining the life of the target, since it is dependent on the reliability of the accelerator and quality of the proton beam. The commissioning of an accelerator system and bringing it up to high beam intensities have their own special problems. There must be protection of components against uncontrolled beam loss, which produces thermal damage, prompt radiation and induced activity. Fast beam trips for beam loss protection, or equipment failures, result in quenches from high temperature in the target which get bigger with increasing beam intensity. But the target itself is a difficult device to make, taking about 12 months to manufacture. Further, changing one is a complex and time consuming task, not without its hazards. There is thus something of a balancing act to bring the accelerator towards specification before the target fails due to thermal cycling fatigue. In the early days of ISIS beam loss protection was the dominant consideration and the target was regarded somewhat as a sacrificial lamb to the goddess of machine reliability. 2 refs., 6 figs.

51948 (LA-UR–89-2920, pp. 10, Paper 8) **Shielding concerns at a spallation source.** Russell, G.J. (Los Alamos Neutron Scattering Center, NM (USA)); Robinson, H.; Legate, G.L.; Woods, R. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

Neutrons produced by 800-MeV proton reactions at the Los Alamos Neutron Scattering Center spallation neutron source cause a variety of challenging shielding problems. The authors identify several characteristics distinctly different from reactor shielding and compute the dose attenuation through an infinite slab/shield composed of iron (100 cm) and borated polyethylene (15 cm). Their calculations show that (for an incident spallation spectrum characteristic of neutrons leaking from a tungsten target at 90%) the dose through the shield is a complex mixture of neutrons and gamma rays. High-energy (> 20 MeV) neutron production from the target is ≅ 5% of the total, yet causes ≅ 68% of the dose at the shield surface. Primary low-energy (< 20 MeV) neutrons from the target contribute negligibly (≅ 0.5%) to the dose at the shield surface yet cause gamma rays, which contribute ≅ 31% to the total dose at the shield surface. Low-energy neutrons from spallation reactions behave similarly to neutrons with a fission spectrum distribution. 6 refs., 8 figs., 1 tab.

51949 (LA-UR–89-2920, pp. 18, Paper 9) **Target system materials and engineering problems.** Fischer, W.E. (Paul Scherrer Institute, Villigen (Switzerland)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

This paper discusses the common problems of target design. As a model for the discussion, the author considers a spallation source which is fed by a high power proton beam of the order of one megawatt. The materials used for the target station and particularly for the spallation target itself depend on whether the source is built for pulsed, modulated or continuous operation. The difference of materials used is mainly determined by the neutronics considerations. Depending on the choice of materials for the target systems, the characters of material problems met, are of somewhat different nature. It is recognized that for each target version quite specific difficulties have to be overcome. On the other hand, there is a whole set of problems which is common to all target versions. These are: heat load in region of proton beam interactions; thermal stress and cycling; and radiation damage. It is shown that solutions to the whole package of problems up to a beam power of 0 (1MW) have been found. The whole effort concentrates onto the region of the first few centimeters of beam penetration. Two solutions have been proposed: (1) Keep the power of proton beam limited and produce neutrons elsewhere in the target. and (2) Dilute the power by moving mechanically the target and the window. 8 refs., 11 figs.

51950 (LA-UR–89-2920, pp. 21, Paper 10) **Cold moderator scattering kernels.** MacFarlane, R.E. (Los Alamos National Laboratory, NM (USA)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

New thermal-scattering-law files in ENDF format have been developed for solid methane, liquid methane liquid ortho- and para-hydrogen, and liquid ortho- and para-deuterium using up-to-date models that include such effects as incoherent elastic scattering in the solid, diffusion and hindered vibration and rotations in the liquids, and spin correlations for the hydrogen and deuterium. These files were generated with the new LEAPR module of the NJOY Nuclear Data Processing System. Other modules of this system were used to produce cross sections for these moderators in the correct format for the continuous-energy Monte Carlo code (MCNP) being used for cold-moderator-design calculations at the Los Alamos Neutron Scattering Center (LANSCE). 20 refs., 14 figs.

51951 (LA-UR–89-2920, pp. 14, Paper 11) **Cold moderators for spallation sources.** Lucas, A.T. (Rutherford-Appleton Laboratory, Oxon (England)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

Moderators using both liquid and solid methane and liquid hydrogen are currently in use at major spallation neutron sources. Los Alamos Neutron Scattering Center (LANSCE) is planning the use of liquid methane as part of a major update program planned in about three years time. This report presents an overview of some of these devices and outlines the general engineering design of the proposed LANSCE moderator, including some suggested solutions to the radiation damage problems of methane. Also included is a brief overview of a possible combined H_2/CH_4 moderator for high-intensity proton beams, which is covered in more detail in a separate paper. 15 figs.

51952 (LA-UR–89-2920, pp. 12, Paper 12) **The advanced MAPLE reactor concept.** Lidstone, R.F. (Atomic Energy of Canada Limited, Pinawa, Manitoba); Lee, A.G.; Gillespie, G.E.; Smith, H.J. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

In Canada the need for advanced neutron sources has long been recognized. During the past several years Atomic Energy of Canada Limited (AECL) has been developing the new MAPLE multipurpose reactor concept. To date, the MAPLE program has focused on the development of a modest-cost multipurpose medium-flux neutron source to meet contemporary requirements for applied and basic research using neutron beams, for small-scale materials testing and analysis and for radioisotope production. The basic MAPLE concept incorporates a compact light-water cooled and moderated core within a heavy water primary reflector to generate strong neutron flux levels in a variety of irradiation facilities. In view of renewed Canadian interest in a high-flux neutron source, the MAPLE group has begun to explore advanced concepts based on AECL's experience with heavy water reactors. The overall objective is to define a high-flux facility that will support materials testing for advanced power reactors, new developments in extracted neutron-beam applications, and/or production of radioisotopes. The design target is to attain performance levels of HFR-Grenoble, HFBR, HFIR in a new heavy water-cooled, -moderated,-reflected reactor based on rodded LEU fuel. Physics, shielding, and thermohydraulic studies have been performed for the MAPLE heavy water reactor. 14 refs., 4 figs., 1 tab.

51953 (LA-UR–89-2920, pp. 13, Paper 13) **Design calculations for the ANS (Advanced Neutron Source) cold source.** Lillie, R.A. (Oak Ridge National Lab., TN (USA)); Alsmiller, R.G. Los Alamos National Lab., NM (USA). Mar 1989. DOE Contract AC05-84OR21400. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The calculational procedure, based on discrete ordinates transport methods, that is being used to carry out design calculations for the Advanced Neutron Source cold source is described. Calculated results on the gain in cold neutron flux produced by a liquid-deuterium cold source are compared with experimental data and with calculated data previously obtained by P. Ageron, et al., at the Institute Max von Laue-Paul Langevin in Grenoble, France. Calculated results are also presented that indicate how the flux of cold neutrons vary with cold-source parameters. 23 refs., 5 figs., 3 tabs.

51954 (LA-UR–89-2920, pp. 12, Paper 15) **Introduction to maximum entropy.** Sivia, D.S. (Los Alamos National Lab., NM (USA)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The maximum entropy (MaxEnt) principle has been successfully used in image reconstruction in a wide variety of fields. The author reviews the need for such methods in data analysis and shows, by use of a very simple example, why MaxEnt is to be preferred over other regularizing functions. This leads to a more general interpretation of the MaxEnt method, and its use is illustrated with several different examples. Practical difficulties with non-linear problems still remain, this being highlighted by the notorious phase problem in crystallography. He concludes with an example from neutron scattering, using data from a filter difference spectrometer to contrast MaxEnt with a conventional deconvolution. 12 refs., 8 figs., 1 tab.

51955 (LA-UR–89-2920, pp. 6, Paper 16) **New instruments at IPNS (Intense Pulsed Neutron Source): POSY II and SAD II.** Crawford, R.K. (Argonne National Lab., IL (USA)); Felcher, G.P.; Kleb, R.; Epperson, J.E.; Thiyagarajan, P. Los Alamos National Lab., NM (USA). Mar 1989. DOE Contract W-31-109-ENG-38. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

Three new instruments are currently in varying degrees of development/construction at IPNS. One of these, the Glass, Liquid, and Amorphous Materials Diffractometer (GLAD) is the subject of a separate paper in these proceedings and so will not be discussed further here. The other two, a second neutron reflectometer (POSY II) and a second small-angle diffractometer (SAD II), are described briefly below. 5 refs., 1 fig., 1 tab.

51956 (LA-UR–89-2920, pp. 25, Paper 18) **Developments in inelastic instrumentation at ISIS.** Taylor, A.D. (Rutherford Appleton Laboratory, Oxon (England)); Bowden, Z.A.; Carlile, C.J.; Hagen, M.E.; Hannon, A.C.; Holt, R.S.; Mayers, J.; Osborn, R.; Paoli, M.P.; Robertson, S.T.; Smith, A.; Steigenberger, U.; Tomkinson, J.; Williams, W.G. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The authors summarize developments on the three scheduled inelastic spectrometers HET, TFXA and IRIS and illustrate their scientific program with some recent highlights. They give details of commissioning experiments on PRISMA and discuss the status of the eVS and polarization programs. The status of the MARI project is reviewed. 15 refs., 22 figs.

51957 (LA-UR–89-2920, pp. 13, Paper 19) **Development of a chopper spectrometer at Kens.** Arai, M. (National Laboratory for High Energy Physics, Ibaraki-Ken (Japan)); Kohgi, M.; Itoh, M.; Iwasa, H.; Watanabe, N.; Ikeda, S.; Endoh, Y. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

A direct geometry chopper spectrometer combined with an advanced pulsed neutron source has a promising feasibility for its wide accessible dynamic range in Q-ω space and for the applicable various fields of high energy magnetic excitations, molecular dynamics and dynamics of liquids and glasses. The recent scientific requirements of measuring high energy excitations caused the decision to build a chopper spectrometer at KENS. The development of a sophisticated magnetic bearing made it possible to realize a short chopper burst, due to the high speed revolution, as narrow as the neutron pulse width from a moderator in the epithermal neutron region, providing higher momentum and energy resolution with less sacrifice in intensity. In this report the authors discuss a spectrometer called INC, which is under construction at KENS, aiming at neutron scattering with an energy transfer from 20 to 1,000 meV and a momentum transfer from 0.3 to 40$Å^{-1}$. 11 refs., 7 figs.

51958 (LA-UR–89-2920, pp. 1, Paper 21) **Neutron Brillouin scattering in dense nitrogen gas.** Egelstaff, P.A. (Univ. of Guelph (Canada)); Kearley, G.; Suck, J.B.; Youden, J.P.A. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

In order to develop the field of neutron Brillouin scattering, the authors have assembled a new neutron spectrometer system and have used it to study the scattering from dense nitrogen gas at wave numbers from 0.05 to 0.15 $Å^{-1}$. They have demonstrated both that the new system is efficient and successful, and that these new data conform to existing theory.

51959 (LA-UR–89-2920, pp. 12, Paper 23) **Application of eV neutron scattering and eV neutron absorption techniques.** Ikeda, Susumu (National Laboratory for High Energy Physics, Ibaraki-ken (Japan)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced

neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

Intense spallation neutron sources can provide a useful eV neutron flux in the energy range 1-100 eV, which is much more intense than has even been available from steady-state sources, and makes two fruitful techniques possible. One is an eV neutron scattering technique. The other is an eV neutron absorption technique. The discovery of superconductivity in the temperature range 30-100 K for the La-Cu-O system and the Y-Ba-Cu-O system is one of the most exciting events in recent solid state physics. Many attempts to explain such extraordinary high Tc values have been made with conventional electron-phonon coupling theory as well as with non-phonon mechanisms. The most direct test for such theories is to look for predicted excitations by using inelastic neutron scattering techniques. The eV neutron scattering and eV neutron absorption experiments can provide new important information for the high Tc mechanism, which has never been obtained by ordinary neutron scattering experiments. For the first time, the author applies these methods to the observation of motions of specific atoms in La-Cu-O and Y-Ba-Cu-O systems. In this paper, he reports a procedure of the application. 17 refs., 8 figs., 1 tab.

51960 (LA-UR–89-2920, pp. 14, Paper 24) **Future perspectives for liquids and amorphous materials diffraction at ISIS.** Soper, A.K. (Rutherford Appleton Laboratory, Oxon (England)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

A review is given of the current state of neutron diffraction from liquids and amorphous materials at ISIS. In particular the justification and status of the SANDALS diffractometer, which is now undergoing detailed design and construction is reviewed, and compared with competing diffractometers in Europe and the U.S.A. A general description of this instrument is included. 8 refs., 7 figs., 2 tabs.

51961 (LA-UR–89-2920, pp. 6, Paper 25) **A comparison of germanium and copper analyzers for pulsed-source crystal-analyzer spectrometers.** Yethiraj, M. (Los Alamos National Lab., NM (USA)); Robinson, R.A. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The authors describe the new copper organ-pipe analyzer installed on the Los Alamos Constant-Q Spectrometer and compare its performance with the previous germanium analyzer. In addition, they discuss the implications of their experience for pulsed-source crystal-analyzer spectrometers in general. 7 refs., 4 figs.

51962 (LA-UR–89-2920, pp. 7, Paper 27) **The new chopper spectrometer at LANSCE [Los Alamos Neutron Scattering Center] , PHAROS.** Robinson, R.A. (Los Alamos National Lab., NM (USA)); Nutter, M.; Silver, R.N.; Hooten, D.T.; Ricketts, R.L. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The authors describe the new chopper spectrometer PHAROS under design at Los Alamos. It is intended to provide 0.5% incident energy resolution for incident energies between 50 meV and 2 eV. This will be achieved with a methane moderator and a 20-m incident flight path on Flight Path 16 of the Los Alamos Neutron Scattering Center. The secondary flight path will be 4 m for scattering angles between 10° and 140°. For small scattering angles (down to 0.5°), the secondary flight path can be extended to 10 m. They include results of preliminary tests on phasing a prototype chopper and the Proton Storage Ring. These show that phasing can be achieved and that the width of the transmitted neutron pulse is in reasonable agreement with calculation. 5 refs., 4 figs., 1 tab.

51963 (LA-UR–89-2920, pp. 21, Paper 28) **Time-of-flight small-angle-neutron-scattering data reduction and analysis at LANSCE (Los Alamos Neutron Scattering Center) with program SMR.** Hjelm, R.P. Jr. (Los Alamos National Lab., NM (USA)); Seegar, P.A. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

A user-friendly, integrated system, SMR, for the display, reduction and analysis of data from time-of-flight small-angle neutron diffractometers is described. Its purpose is to provide facilities for data display and assessment and to provide these facilities in near real time. This allows the results of each scattering measurement to be available almost immediately, and enables the experimenter to use the results of a measurement as a basis for other measurements in the same instrument allocation. 8 refs., 11 figs.

51964 (LA-UR–89-2920, pp. 7, Paper 29) **Some considerations on TOF-NSE (Time-Of-Flight-Neutron Spin Echo).** Ikeda, S. (National Laboratory for High Energy Physics, Ibaraki-ken (Japan)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

Recently a future plan of a huge spallation neutron source has been proposed in a framework of the Japan Hadron Project (JHP), in which accelerated protons with 100-200 μA and 1-2 GeV will be used for the production of neutrons. Here, as a new concept, a unique cold moderator is considered, which can produce high intense pulsed-cold-neutrons with the extreme wide burst-width. It if will be realized, it will confer benefits on elastic scattering TOF-instruments, such as SAN in KENS, which does not require high time-resolution. However, it is a devil for ordinary inelastic scattering TOF-spectrometers with high energy-resolution such as LAM in KENS. In these inelastic spectrometers, high time-resolution is required and the energy-resolution is approximately given by 2(burst-width)/(time-of-flight). It means that the ordinary inelastic scattering spectrometer with $\varepsilon/E_i = 0.005$ must be constructed much farther from this moderator, at about 300 m. Because the area of JHP is very small, it is hard to prepare such a long flight path. Even if it could be constructed with the long flight path, the available band-width of neutron wavelength becomes very small. For our future plan, many attempts should be performed to invent a new type of the TOF-spectrometer, which can realize the high energy-resolution even in the condition of a short distance and a wide burst-width on various spectrometers, including the ordinary one. The TOF spin-echo method (TOF-NSE) is one candidate for these trials. The pure spin-echo method has been already realized on the steady state sources, and many low energy excitations in magnetic systems, polymers and so on, have been observed. TOF-NSE was proposed by Mezei in 1979 but not still realized at the spallation neutron sources. At KENS, a test machine of TOF-NSE was constructed in 1983. 2 refs., 5 figs.

51965 (LA-UR–89-2920, pp. 2, Paper 30) **Optimal Larmor precession magnets: Application to neutron spin echo.** Zeyen, C.M.E. (Institut Laue Langevin, Grenoble (France)); Rem, P.C.; Hartmann, R.A.; ten Kate, H.H.J.; van de Klundert, L.J.M. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

Resolution characteristics of neutron spectrometers using Larmor precession of the neutron spin are presently limited by magnetic field homogeneities of a special type. The authors present an analytical solution to the variational problem $\int^L |B|\, dl$ = constant for the

case of cylindrical magnets coaxial to the beam axis. This solution describes the best irrotational field shape along the beam axis z. The optimal homogeneity is significantly better than for a simple solenoid of comparable dimensions. Improved neutron economy can be achieved because our magnets can be made much shorter than solenoids. For realistic lengths L and beam radii r, it is, however, not good enough for high-resolution spectroscopy. Therefore, they studied a way to correct both for the residual inhomogeneities of cylinder magnets and the line-integral variations caused by path-length differences, which result from finite angular beam divergence. Such corrections can only be done by introducing current distributions in the beam. Their optimal distributions can also be calculated analytically, and the authors present a way of implementing them in practice. In addition, they discuss the application of the same correction technique to other magnets, demonstrating that it is useful in general for cylinder-symmetric magnets such as solenoids. With magnets designed and corrected this way, the Larmor phase angle is a unique measure of the neutron energy and the resolution of spectroscopic methods using Larmor precession, such as LPS, which allows spectrum determination before or after scattering, or more sophisticated techniques, such as NSE and NMS, for example, is not influenced by corrections or other limitations caused by imperfect magnets.

51966 (LA-UR–89-2920, pp. 8, Paper 31) **Soller collimators for small angle neutron scattering.** Crawford, R.K. (Argonne National Laboratory, IL (USA)); Epperson, J.E.; Thiyagarajan, P. Los Alamos National Lab., NM (USA). Mar 1989. DOE Contract W-31-109-ENG-38. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The neutron beam transmitted through the soller collimators on the SAD (Small Angle Diffractometer) instrument at IPNS (Intense Pulsed Neutron Source) showed wings about the main beam. These wings were quite weak, but were sufficient to interfere with the low-Q scattering data. General considerations of the theory of reflection from homogeneous absorbing media, combined with the results from a Monte Carlo simulation, suggested that these wings were due to specular reflection of neutrons from the absorbing material on the surfaces of the collimator blades. The simulations showed that roughness of the surface was extremely important, with wing background variations of three orders of magnitude being observed with the range of roughness values used in the simulations. Based on the results of these simulations, new collimators for SAD were produced with a much rougher ^{10}B-binder surface coating on the blades. These new collimators were determined to be significantly better than the original SAD collimators. This work suggests that any soller collimators designed for use with long wavelengths should be fabricated with such a rough surface coating, in order to eliminate (or at least minimize) the undesirable reflection effects which otherwise seem certain to occur. 4 refs., 6 figs.

51967 (LA-UR–89-2920, pp. 14, Paper 33) **Monte Carlo simulation of the LANSCE target/moderator/reflector/shield geometry.** Hughes, H.G. III (Los Alamos National Lab., NM (USA)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The author presents a detailed computer model of the existing LANSCE Target/Moderator/Reflector/Shield system. He describes the HETC/MCNP Monte Carlo code system used with this model, and he introduces a calculation designed to make comparisons with experimental results. 10 refs., 7 figs., 2 tabs.

51968 (LA-UR–89-2920, pp. 4, Paper 34) **Experimental determination of neutron beam fluxes at LANSCE (Los Alamos Neutron Scattering Center) from gold foil activation.** Gilmore, J.S. (Los Alamos National Lab., NM (USA)); Robinson, R.A.; Russell, G.J. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The purpose of this work was threefold: (1) to measure fluxes at the experimental locations for more efficient design and use of the instruments; (2) to compare measured fluxes with those predicted by state-of-the-art Monte Carlo computer code calculations incorporating a detailed mockup of the LANSCE target-moderator-reflector-shield geometry; and (3) to compare the fluxes from the unique flux-trap design with more conventional target-moderator systems of ISIS and Zing-P. T.G. Worlton and J.M. Carpenter at Argonne measured the 1-eV fluxes directly by using cadmium-shielded 22.56-mg/cm^2 thick gold foils. They determined the necessary self-shielding corrections by irradiating a stack of three foils. Preliminary corrections were applied to the specific activities of the foils using the approximation for the self-shielding correction g. Their final values for the corrected specific activities were then determined by extrapolating the proximate results as a function of foil thickness to zero thickness. The measurements at LANSCE parallel these experiments for the 1-eV flux. The authors have, however, irradiated bare Au foils for additional data on the subcadmium flux. In the future they plan to use a modified cadmium-difference method, taking into account the undermoderated spectrum from a pulsed-spallation source, which is rich in epithermal neutrons. 5 refs., 1 tab.

51969 (LA-UR–89-2920, pp. 10, Paper 35) **The D_2 cold-neutron source for SINQ.** Atchison, F. (Paul Scherrer Institute, Villigen (Switzerland)); Bucher, W.; Hoechli, A.; Horvath, I.; Nordstroem, L. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

This report describes the present state of the design for a D_2 cold neutron source for SINQ. The source is to provide neutrons in the wavelength range 2 to 12 Å for a guide-system and at two beam ports. The basis of the design is an adaptation of the horizontally mounted thermosyphon as used for the second cold-source at the ILL, Grenoble. The principal advantages of the thermosyphon are as follows: high heat-transfer rates at cryogenic temperatures are easily achieved, the system is basically passive and self-regulating, and minimization of the cooling power required by allowing, for instance, the condenser/phase-separator system to be removed from the high heating region. So far, work has been concentrated on the cryogenic part of the source, which is in the region of the bulk shield. The main considerations for the design are outlined. 4 refs., 8 figs.

51970 (LA-UR–89-2920, pp. 6, Paper 36) **LANSCE (Los Alamos Neutron Scattering Center) steady-state unperturbed thermal neutron fluxes at 100 μA.** Russell, G.J. (Los Alamos Neutron Scattering Center, NM (USA)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The maximum unperturbed, steady-state thermal neutron flux for LANSCE is calculated to be 2 x 10^{13} n/cm^2-s for 100 μA of 800-MeV protons. This LANSCE neutron flux is a comparable entity to a steady-state reactor thermal neutron flux. LANSCE perturbed steady state thermal neutron fluxes have also been calculated. Because LANSCE is a pulsed neutron source, much higher peak (in time) neutron fluxes can be generated than at a steady-state reactor source. 5 refs., 5 figs.

51971 (LA-UR–89-2920, pp. 14, Paper 37) **LANSCE (Los Alamos Neutron Scattering Center) target system performance.** Russell, G.J. (Los Alamos Neutron Scattering Center, NM (USA)); Gilmore, J.S.; Robinson, H.; Legate, G.L.; Bridge, A.; Sanchez, R.J.; Brewton, R.J.; Woods, R.; Hughes, H.G. III. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The authors measured neutron beam fluxes at LANSCE using gold foil activation techniques. They did an extensive computer simulation of the as-built LANSCE Target/Moderator/Reflector/Shield geometry. They used this mockup in a Monte Carlo calculation to predict LANSCE neutronic performance for comparison with measured results. For neutron beam fluxes at 1 eV, the ratio of measured data to calculated varies from ≈0.6-0.9. The computed 1 eV neutron leakage at the moderator surface is 3.9 x 10^{10} n/eV-sr-s-μA for LANSCE high-intensity water moderators. The corresponding values for the LANSCE high-resolution water moderator and the liquid hydrogen moderator are 3.3 and 2.9 x 10^{10}, respectively. LANSCE predicted moderator intensities (per proton) for a tungsten target are essentially the same as ISIS predicted moderator intensities for a depleted uranium target. The calculated LANSCE steady state unperturbed thermal (E < 0.625 eV) neutron flux (at 100 μA of 800 MeV-protons) is 2 x 10^{13} n/cm^2-s. The unique LANSCE split-target/flux-trap-moderator system is performing exceedingly well. The system has operated without a target or moderator change for over three years at nominal proton currents of 25 μA of 800-MeV protons. 17 refs., 8 figs., 3 tabs.

51972 (LA-UR–89-2920, pp. 8, Paper 37) **Scattering cross sections and transport properties of H_2 and D_2 as obtained from a synthetic model.** Granada, J.R. (Centro Atomico Bariloche and Instituto Balseiro (Argentina)); Gillette, V.H.; Sbaffoni, M.M.; Mayer, R.E. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

In the frame of a synthetic scattering function, the interaction of slow neutrons with H_2 and D_2 is described in a simple way. The main advantage of the synthetic model is contained in the analytical expressions it produces for the total cross section and the isotropic and anisotropic energy-transfer kernels. They allow a very fast evaluation of neutron scattering and transport properties in liquid hydrogen and deuterium, including variation of the concentration in the ortho and para forms. The calculations are compared with available experimental data, showing very good agreement. The results presented here are relevant to cold neutron source design. 17 refs., 9 figs.

51973 (LA-UR–89-2920, pp. 3, Paper 39) **Upgrading of the reactor BER II.** Axmann, A. (Hahn-Meitner Institut, Berlin (Germany, F.R.)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The Berlin Research Reactor BER II at the Hahn-Meitner Institut is a swimming pool reactor. The BER II was operated at a power of 5 MW from December 1973 until it was shut down in August 1985 for a general physical and technical improvement and upgrading. The neutron fluxes available at the beam tube positions in the reflector will be about 10^{14}n/cm^{2}sec. The upgraded BER II will be a medium-flux neutron source for standard applications, such as neutron scattering, materials research, and activation analysis, the latter of which is used mainly for medical problems. The flux density of cold neutrons will be further increased by a factor of 13 by a cold neutron source. Six neutron guides will feed a new neutron guide hall of approximately 1200 m^2. The licensing authorities require backfitting according to current regulations for science and technology for technical improvement. A large number of guidelines and regulations concerning design, construction and operation of nuclear power plants have had to be followed. Thus, planning permission had to cover the energy supply system, cranes, fire protection system, the security system, the reactor control and safety system, and the storage facilities of fresh unirradiated fuel elements as well as spent-fuel elements. 2 figs., 1 tab.

51974 (LA-UR–89-2920, pp. 6, Paper 40) **New moderator for pulsed neutron diffraction.** Mayer, R.E. (Centro Atomico Bariloche and Instituto Balseiro (Argentina)); Granada, J.R.; Gillette, V.H.; Dawidowski, J. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

Experiments of neutron diffraction, leakage spectrum and pulse decay have been carried out on a new geometry, heterogeneously poisoned, set of moderators and on conventional sandwich and slab moderators for comparison purposes. For a given time pulse width, great increase in neutron leakage intensity has been found in these assemblies, up to 2.7 times that of a sandwich moderator. Clues to implementation of desired time-response in moderator design and of further increases in neutron yields are suggested by present results. 8 refs., 4 figs., 1 tab.

51975 (LA-UR–89-2920, pp. 6, Paper 41) **Detector development at the ISIS facility.** Davidson, P.L. (Rutherford-Appleton Laboratory, Oxon (England)); Mott, E.M.; Rhodes, N.J.; Johnson, M.W. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

For many years the Rutherford Appleton Laboratory has had a neutron detector development program. It was undertaken to see if the limitations inherent in conventional He^3 detectors (their speed, efficiency at high neutron energies and rigid geometry) could be overcome by scintillator technologies. It was also underpinned by the fact that it can cost tens of millions of pounds to double the intensity of a neutron source but a few thousand pounds can in some cases double the performance of a neutron scattering instrument if its detection system is improved. The detectors developed up to the present data have been based on Li^6 doped glass scintillator and have been successfully installed and run routinely on the HRPD, LAD and IRIS instruments at ISIS. In fact all the present ISIS instruments make use of the Li^6 glass scintillator technique within their monitors - which comprise small beads of scintillator supported on fine glass filaments in a reflecting housing and viewed directly by a single photomultiplier tube (PMT). The glass scintillators have performed well, with intrinsic backgrounds and γ sensitivities within original specifications. However, it has become clear that on many instruments the neutron background is so low, it is these quantities that are the most important in determining the ultimate signal to noise achievable. To overcome the background and γ sensitivity problems studies have been made of Li^6 loaded ZnS scintillator. This has proved so successful that it is likely this technology will form the basis of the detector program over the next few years. 6 figs.

51976 (LA-UR–89-2920, pp. 8, Paper 42) **New KENS data acquisition system.** Arai, M. (National Laboratory for High Energy Physics, Ibaraki (Japan)); Furusaka, M.; Satoh, S. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

In this report, the authors discuss a data acquisition system, KENSnet, which is newly introduced to the KENS facility. The criteria for the data acquisition system was about 1 MIPS for CPU speed and 150 Mbytes for storage capacity for a computer per spectrometer. VAX computers were chosen with their propreitary operating system, VMS. The Vax computers are connected by a DECnet network mediated by Ethernet. Front-end computers, Apple Macintosh Plus and Macintosh II, were chosen for their user-friendly manipulation and intelligence. New CAMAC-based data acquisition electronics were developed. The data acquisition control program (ICP) and the general data analysis program (Genie) were both developed at ISIS and have been installed. 2 refs., 3 figs., 1 tab.

51977 (LA-UR–89-2920, pp. 11, Paper 43) **Future data acquisition at ISIS.** Pulford, W.C.A. (Rutherford Appleton Laboratory, Oxon (England)); Quinton, S.P.H.; Johnson, M.W.; Norris, J. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS),

Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

Data collection techniques at ISIS are fast reaching the point where the current computer systems will no longer be able to migrate the data to long-term storage, let alone enable their analysis at a speed compatible with continuous use of the ISIS instruments. The current data acquisition electronics (DAE 1) and migration path work effectively but have a number of inherent difficulties: (1) Seven instruments are equipped with VAX computers as their Front End Minicomputers (FEM). Unfortunately these machines usually possess insufficient processor power to perform some of the more complex data reduction. This means that the raw data have necessarily to be networked to the HUB computer before analysis. (2) The size of bulk store memory is restricted to 16 Mbytes by the 24 bit address field of Multibus. (3) The DAE error detection and analysis system of FEM is crude. It is clear that the most effective method to improve on this situation is to reduce the data volume flowing between the DAE and the FEM and to provide facilities to monitor data acquisition within the DAE. For these purposes processing power must be incorporated closer to the point of data collection. It has been decided to implement processing elements within DAE 2 (the next generation of DAE) in the form of intelligent memory boards. 6 figs., 1 tab.

51978 (LA-UR–89-2920, pp. 7, Paper 44) **Upgrades to the ISIS moderator configuration.** Taylor, A.D. (Rutherford Appleton Laboratory, Oxon (England)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

Possible upgrades to the ISIS moderator configuration are discussed in the light of the current and projected instrument suite. 3 refs., 5 figs., 1 tab.

51979 (LA-UR–89-2920, pp. 7, Paper 46) **Pulsed-neutron production at the Brookhaven 200-MeV linac.** Ward, T.E. (Brookhaven National Lab., Upton, NY (USA)); Alessi, J.; Brennan, J.; Grand, P.; Lankshear, R.; Montemurro, P.; Snead, C.L. Jr.; Tsoupas, N. Los Alamos National Lab., NM (USA). Mar 1989. DOE Contract AC02-76CH00016. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The new 750-kV RFQ preinjector and double chopper system capable of selecting single nanosecond micropulses with repetition rates of 0.1 to 20 MHz has been installed at the Brookhaven 200-MeV proton linac. The micropulse intensity is approximately 1 x 10^9 p/μpulse. Neutron time-of-flight path lengths of 30 to 100 meters at 0°, 12°, 30°, 45°, 90° and 135° are available as well as a zero-degree beam swinger capable of an angular range of 0° to 25°. Pulsed neutron beams of monoenergetic ($p^7Li \rightarrow n^7Be$) and spallation ($p^{238}U \rightarrow nx$) sources will be discussed in the present paper as well as detailing the chopped-beam capabilities. 11 refs., 5 figs., 1 tab.

51980 (LA-UR–89-2920, pp. 3, Paper 47) **The LANSCE (Los Alamos Neutron Scattering Center) target data collection system.** Kernodle, A.K. (Los Alamos Neutron Scattering Center, NM (USA)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The Los Alamos Neutron Scattering Center (LANSCE) Target Data Collection System is the result of an effort to provide a base of information from which to draw conclusions on the performance and operational condition of the overall LANSCE target system. During the conceptualization of the system, several goals were defined. A survey was made of both custom-made and off-the-shelf hardware and software that were capable of meeting these goals. The first stage of the system was successfully implemented for the LANSCE run cycle 52. From the operational experience gained thus far, it appears that the LANSCE Target Data Collection System will meet all of the previously defined requirements.

51981 (LA-UR–89-2920, pp. 4, Paper 48) **Liquid-hydrogen-control-system modifications.** Summers, T. (Los Alamos Neutron Scattering Center, NM (USA)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

By late 1987, the Los Alamos Neutron Scattering Center (LANSCE) liquid-hydrogen-control-system electronics had evolved to a functionally adequate stage, but occasionally showed signs that rebuilding was needed. The rebuild offered opportunity to redesign the external features of the system, which are described in this paper along with some technical features. 4 figs.

51982 (LA-UR–89-2920, pp. 14, Paper 49) **Remote handling for an ISIS target change.** Broome, T.A. (Rutherford Appleton Laboratory, Oxford (England)); Holding, M. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

During 1987 two ISIS targets were changed. This document describes the main features of the remote handling aspects of the work. All the work has to be carried out using remote handling techniques. The radiation level measured on the surface of the reflector when the second target had been removed was about 800 mGy/h demonstrating that hands on operations on any part of the target reflector moderator assembly is not practical. The target changes were the first large scale operations in the Target Station Remote Handling Cell and a great deal was learned about both equipment and working practices. Some general principles emerged which are applicable to other active handling tasks on facilities like ISIS and these are discussed below. 8 figs.

51983 (LA-UR–89-2920, pp. 8, Paper 50) **LANSCE (Los Alamos Neutron Scattering Center) target calculations.** Grisham, D.L. (Los Alamos National Lab., NM (USA)); Brown, R.D. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The LANSCE target presently operates at a beam current of 30 μA. The authors present here the results of the finite-element calculations for the temperatures and stresses in the present target operated at 100 μA. The calculations were run using the ABAQUS finite-element code. All finite-element codes require as input both the boundary conditions for the material being heated and such material properties as the thermal conductivity, specific heat, and the elastic modulus. For the LANSCE target, the boundary conditions involve knowing the power deposition from the beam, and the heat-transfer coefficients between the tungsten-alloy cylinder and the cooling water. The target material is a powder metallurgy alloy of tungsten, iron, and nickel (96.2% W, 3.8% Fe and Ni). Although the properties of pure tungsten are well known, the properties of this particular alloy have not been found in the literature. 5 refs., 6 figs.

51984 (LA-UR–89-2920, pp. 2, Paper 51) **Summary of contribution to the ICANS-X panel discussion.** Bowman, C.D. (Los Alamos National Lab., NM (USA)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

In this paper the author discusses spallation source development in general. He discusses the future relationship between spallation sources and emphasizes that each laboratory is unique and that all

laboratories lose by pushing toward some norm rather than by taking advantage of each labs individuality. He illustrates this by some remarks about the challenge to Los Alamos from other spallation sources and by suggesting a response.

51985 (LA-UR–89-2920, pp. 1, Paper 52) **Summary of contribution to the ICANS-X panel discussion.** Crawford, K. (Argonne National Lab., IL (USA)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

In general, users don't care about the source characteristics or even the type of source–what they care about is the performance of specific instruments for specific experiments. It is the instrument designers who dictate what source characteristics are necessary or desirable to achieve specific levels of instrument performance. From an instrument designer's point of view, the time-structure (pulse shape and repetition frequency) of the source and the time-averaged intensity as a function of wavelength are the two most important source parameters. Clearly, the source time-structure is of fundamental importance to those instruments based on traditional time-of-flight techniques. However, source time-structure can also be of considerable importance to some instruments that traditionally have been operated in a steady-state mode. If new sources are being designed, some of these traditional techniques should be reexamined from this point of view. Many instruments are now operated with a less-than-optimum source time-structure and could achieve significant performance improvements if the source time-structure were optimized. Consider, for example, the small-angle scattering instruments currently operating at pulsed spallation neutron sources. For these instruments, the pulses are typically much narrower than required, so lengthening the pulses could lead to significant gains in data rates with no appreciable loss in resolution. Another example is the triple-axis spectrometers, which have been so important at steady-state sources. One of the great advantages of pulsed sources is the flexibility they provide in optimizing source time-structure and intensity-vs-wavelength characteristics. Moderators can be cold, hot, small and decoupled, or large and coupled.

51986 (LA-UR–89-2920, pp. 1, Paper 54) **User requirements as they impact spallation neutron source design.** Egelstaff, P.A. (Univ. of Guelph, Ontario (Canada)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

Experiments completed with the existing sources worldwide have shown that much good work can be done with present flux levels. In many cases the urgent need is for long-term stable running conditions. After this has been achieved there will be further requests for higher power levels, but again long-term stable running conditions will be emphasized as crucial to many experiments. In addition, many users work in other areas of physics and different disciplines and are not used to the problems of working in a high-energy physics environment. They need user friendly facilities and support services. Such services will also increase the productivity of all users and, therefore, should be regarded as essential. The points made above require the continuous attention of administrators and managers and should be given priority over any features that have been introduced for administrative or managerial convenience.

51987 (LA-UR–89-2920, pp. 1, Paper 55) **Summary of the contributions to the ICANS-X panel discussion.** Mezei, F. (Hahn-Meitner Institute, Berlin (Germany, F.R.)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The field of high-resolution inelastic spectroscopy at pulsed neutron sources is still at its beginnings. However, a closer analysis of the opportunities reveals that in this particular field of applications, the pulsed nature of these sources offers distinct advantages compared to continuous sources. Assuming that the resolution improvement is achieved by using longer flight paths, the intensity penalty turns out to be just proportional to the resolution increase, because either the pulse length or the wavelength band can be kept constant. This is in contrast to losses increasing with higher powers of the resolution gain on continuous sources. In any case, the main limiting factor is inelastic spectroscopy, in general, and in high-resolution spectroscopy, in particular, is the neutron intensity. Therefore, flexibility of resolution is crucial to obtain the optimal resolution-intensity compromise for the particular feature studied. The main implications of these considerations concerning the characteristics of an optimally adapted neutron source are: (a) low pulse repetition rate is to be preferred (some 10 Hz or less) to allow the use of long flightpaths; and (b) best flexibility for optimizing resolution and intensity is provided by maximum intensity, unpoisoned, and coupled (big fat) moderators and pulse-shaping choppers. By now it is perfectly clear that the best performance in the next generation of neutron sources can be expected from advanced pulsed sources as opposed to reactors, not only at short wavelengths where pulsed sources have already proved to be superior, but over the whole spectrum of wavelengths and applications. A pulsed source offering some hundred times the effective useful flux of ILL might be within the realm of the possible by the turn of the century.

51988 (LA-UR–89-2920, pp. 12, Paper 58) **The U.S. Advanced Neutron Source.** West, C.D. (Oak Ridge National Lab., TN (USA)). Los Alamos National Lab., NM (USA). Mar 1989. DOE Contract AC05-84OR21400. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The Advanced Neutron Source (ANS) is to be a new user experimental facility for all fields of neutron research. The most important scientific justification for the ANS Project is to provide intense beams of neutrons for scattering and other experiments: neutron scattering is a primary tool of basic and applied materials science. Facilities will also be provided for engineering materials irradiation tests, isotope production (including transplutonium elements), and materials analysis. More than 1,000 users per year are expected to carry out experiments at the ANS facility. The source of neutrons will be a steady-state reactor designed to maximize the thermal neutron flux available outside the core, where it is accessible to neutron beam tubes and guides. The objectives of the ANS Project are: (1) to design and construct the world's best research reactor for neutron scattering; (2) to provide isotope production facilities that are as good as, or better than the High Flux Isotope Reactor (HFIR); and (3) to provide materials irradiation facilities that are as good as or better than, the HFIR. In addition to these objectives, certain constraints have been placed on the reactor designers. Specifically, safety issues and technical risks are to be minimized by basing the reactor as far as possible on known technology; in particular, the design should not rely on the development of new technology to meet the minimum design criteria. However, research and development (R&D) work that could lead to further major improvements in performance will be identified and planned. Furthermore, a high availability of the reactor should be provided to users. This constraint implies a minimum core life of about 14 d that, in conjunction with an average shutdown of 3 d/cycle or 65 d/year, would give an availability of more than 80%. 4 refs., 8 figs., 5 tabs.

51989 (LA-UR–89-2920, pp. 11, Paper 60) **Information content of lineshapes.** Silver, R.N. (Los Alamos National Lab., NM (USA)); Sivia, D.S.; Pynn, R. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The authors examine the question of figures-of-merit for optimizing the lineshapes of neutron scattering sources, instruments and experiments. Using maximum entropy deconvolution of simulated data, they test the effects of various features of lineshapes including intensity, resolution (FWHM), shape, and background. They demonstrate that conventional figures-of-merit are of limited validity, and

they suggest that bandwidth is an important criterion for optimization. 9 refs., 7 figs.

51990 (LA-UR–89-2920, pp. 10, Paper 62) **Maximum entropy methods in neutron scattering: Application to the structure factor problem in disordered materials.** Soper, A.K. (Rutherford Appleton Laboratory, Oxon (England)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

Maximum entropy methods are becoming increasingly important in the analysis of neutron scattering data, principally for the deconvolution of the instrumental resolution function from measured data, and for the inversion of structure factor data to pair correlation function. It is demonstrated that maximizing the entropy of the estimated distribution does not necessarily guarantee that the inverted distribution is free from artifacts associated with the truncation, noise and systematic effects in the data: the result can depend quite markedly on the assumed prior distribution used to calculate the entropy. For the structure problem a novel exponential weight on the Fourier coefficients is introduced which serves to ensure that the structure factor and its derivatives are continuous. The rate of exponential decay, which is related to the width of the narrowest peak in the structure factor is determined by an inverse correlation length that can be obtained from the data. In this way the results are markedly less dependent on the assumed prior distribution. 8 refs., 6 figs.

51991 (LA-UR–89-2920, pp. 14, Paper 63) **Optimization of reconstruction algorithms using Monte Carlo simulation.** Hanson, K.M. (Los Alamos National Lab., NM (USA)). Los Alamos National Lab., NM (USA). Mar 1989. DOE Contract W-7405-ENG-36. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

A method for optimizing reconstruction algorithms is presented that is based on how well a specified task can be performed using the reconstructed images. Task performance is numerically assessed by a Monte Carlo simulation of the complete imaging process including the generation of scenes appropriate to the desired application, subsequent data taking, reconstruction, and performance of the stated task based on the final image. The use of this method is demonstrated through the optimization of the Algebraic Reconstruction Technique (ART), which reconstructs images from their projections by a iterative procedure. The optimization is accomplished by varying the relaxation factor employed in the updating procedure. In some of the imaging situations studied, it is found that the optimization of constrained ART, in which a nonnegativity constraint is invoked, can vastly increase the detectability of objects. There is little improvement attained for unconstrained ART. The general method presented may be applied to the problem of designing neutron-diffraction spectrometers. 11 refs., 6 figs., 2 tabs.

51992 (LA-UR–89-2920, pp. 14, Paper 64) **Design for a second-generation proton storage ring at LAMPF.** Colton, E.P. (Los Alamos National Lab., NM (USA)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

A conceptual design is presented for a second-generation proton storage ring complex at LAMPF. The facility would consist of two stacked racetrack-shaped machines. These machines would deliver a 1.2-mA beam of 1.6-GeV protons at 48 Hz. The pulse length would be 1.75 μsec which represents a time compression of 570. 1 ref., 8 figs., 1 tab.

51993 (LA-UR–89-2920, pp. 10, Paper 65) **Some neutronic calculations for KENS-II.** Kiyanagi, Y. (Hokkaido Univ., Sapparo (Japan)); Arai, M.; Watanabe, N. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

Proton energies of the intense spallation neutron sources currently in operation or designed are in the range Ep $\leq$ 1.1 GeV. Optimization studies of the target station have so far been performed for these proton energies. The KENS-II project has been included in the Japanese Hadron Facility Project where the proton accelerator, a so-called First Ring is shared with Meson Arena for nuclear physics and μSR experiments. The possible highest proton energy for this accelerator is 2 GeV, which is the highest among the world's spallation neutron sources. The authors, therefore, performed some neutronic calculations with 2 GeV protons in order to have a good knowledge of the neutronic characteristics and the optimal parameters of the target station for KENS-II. The fraction of slow neutron intensity versus the proton energy becomes 0.8 for 2 GeV compared to that for 0.8 GeV, and this is higher than 0.67 calculated for source neutrons. The uranium target has a higher neutron productivity, 1.5 times that of the tungsten target, even for 2 GeV protons. The target radius and the moderator axial position have definite optimal values for 2 GeV protons in spite of the broader distribution of the source neutrons in target, and these are essentially similar to the results for 0.8 GeV protons. The broad distribution with a little increase in the maximum luminosity of source neutrons for 2 GeV protons could make it easier to remove the heat load from the target than the case for the same beam-power with lower energy and higher proton current. Therefore, they could conclude that the 2 GeV protons for KENS-II do not have significant difficulties in producing slow neutrons, and that non-fissile material has higher advantages to produce neutrons for higher proton energies. Detailed neutronic calculations are now under way to design a neutron target station for KENS-II. 5 refs., 10 figs.

51994 (LA-UR–89-2920, pp. 8, Paper 66) **A consideration of cold neutron source for KENS-II.** Watanabe, N. (National Laboratory for High Energy Physics, Ibaraki-ken (Japan)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The importance of a coupled cold moderator for small angle neutron scattering experiments with pulsed neutrons is discussed in connection with a cold neutron source for KENS-II. 5 refs., 1 fig., 1 tab.

51995 (LA-UR–89-2920, pp. 15, Paper 67) **Calculation of the spallation product distribution in the evaporation process.** Nishida, T. (Japan Atomic Energy Research Institute, Ibaraki-ken); Kanno, I.; Nakahara, Y.; Takada, H. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

Some investigations are performed for the calculational model of nuclear spallation reaction in the evaporation process. A new version of a spallation reaction simulation code NUCLEUS has been developed by incorporating the newly revised Uno & Yamada's mass formula and extending the counting region of produced nuclei. The differences between the new and original mass formulas are shown in the comparisons of mass excess values. The distributions of spallation products of a uranium target nucleus bombarded by energy (0.38 - 2.9 GeV) protons have been calculated with the new and original versions of NUCLEUS. In the fission component Uno & Yamada's mass formula reproduces the measured data obtained from thin foil experiments significantly better, especially in the neutron excess side, than the combination of the Cameron's mass formula and the mass table compiled by Wapstra, et al., in the original version of NUCLEUS. Discussions are also made on how the mass-yield distribution of products varies dependent on the level density parameter a characterizing the particle evaporation. 16 refs., 7 figs., 1 tab.

51996 (LA-UR–89-2920, pp. 11, Paper 68) **Preliminary optimization experiments of coupled liquid hydrogen moderator for**

KENS-II. Watanabe, N. (National Laboratory for High Energy Physics, Ibaraki-ken (Japan)); Kiyanagi, Y.; Inoue, K.; Furusaka, M.; Ikeda, S.; Arai, M.; Iwasa, H. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

As a preliminary optimization experiment on the cold-neutron source for KENS-II, energy and time distributions of cold neutrons emanating from coupled liquid-hydrogen moderators with and without a premoderator in a graphite reflector were measured and compared with those from a decoupled liquid-hydrogen moderator. The results showed that the energy spectra from the coupled liquid-hydrogen moderators are almost the same as those from a decoupled one. Relative gain of the former to the latter is fairly high, more than 5, and further increases with increasing wavelength. The broadening of the neutron pulse width in coupled moderators at the cold-neutron region is not so significant and only 1.5 times compared to the solid methane moderator presently operated at KENS-II. 2 refs., 12 figs., 1 tab.

51997 (LA-UR–89-2920, pp. 3, Paper 69) **Measured neutron beam line shielding effectiveness of several iron/polyethylene configurations.** Legate, G.L. (Los Alamos Neutron Scattering Center, NM (USA)); Howe, M.L.; Mundis, R.L. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

Neutron and gamma-ray leakage measurements were taken at various stages of shield construction for neutron flight path 5 (the Lash-up flight path) at LANSCE, to compare the relative effectiveness of several configurations. Dose equivalent rates were determined for three categories: low-energy neutrons, below 20 MeV; high-energy neutrons, above 20 MeV; and gamma rays, as measured by hand-held survey instruments. The low-energy neutrons were measured by activation of an indium foil in a paraffin-filled cadmium cannister, sized to be generally insensitive above 20 MeV. High-energy neutrons were measured by (n,2n) production of Carbon 11 in a plastic scintillator with a 20-MeV threshold. Thermal neutrons were not measured at the shield-leakage test points. Room-scattered neutrons were observed by Albatross IV detector readings, which were taken beside the shield as a measure of variation of room background as the shield configuration changed. 1 fig., 1 tab.

51998 (LA-UR–89-2920, pp. 5, Paper 70) **Equivalent spherical-shield-neutron-dose calculations.** Russell, G.J. (Los Alamos Neutron Scattering Center, NM (USA)); Robinson, H. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

Neutron doses through 162-cm-thick spherical shields were calculated to be 1090 and 448 mrem/h for regular and magnetite concrete, respectively. These results bracket the measured data, for reinforced regular concrete, of ~600 mrem/h. The calculated fraction of the high-energy (> 20 MeV) dose component also bracketed the experimental data. The measured and calculated doses were for a graphite beam stop bombarded with 100 nA of 800-MeV protons. 6 refs., 2 figs., 1 tab.

51999 (LA-UR–89-2920, pp. 8, Paper 71) **Infinite slab-shield dose calculations.** Russell, G.J. (Los Alamos Neutron Scattering Center, NM (USA)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The author calculated neutron and gamma-ray equivalent doses leaking through a variety of infinite (laminate) slab-shields. In the shield computations, the author used, as the incident neutron spectrum, the leakage spectrum (< 20 MeV) calculated for the LANSCE (Los Alamos Neutron Scattering Center) tungsten production target at 90° to the target axis. The shield thickness was fixed at 60 cm. The results of the shield calculations show a minimum in the total leakage equivalent dose if the shield is 40-45 cm of iron followed by 20-15 cm of borated (5%B) polyethylene. High-performance shields can be attained by using multiple laminations. The calculated dose at the shield surface is very dependent on shield material. 4 refs., 4 figs., 2 tabs.

52000 (LA-UR–89-2920, pp. 8, Paper 72) **On the use of acceptance diagrams to calculate the performance of multiple-section straight-sided neutron guide systems.** Copley, J.R.D. (Univ. of Maryland, College Park (USA)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The author describes a method to calculate the performance of multiple section systems of straight-sided guides and collimators. The approach is based on the concept of acceptance diagrams, previously described by J.M. Carpenter and D.F.R. Mildner, which display the transverse spatial and angular coordinates of the neutrons in the system. For a given section of guide the construction of the exit diagram, from the entrance diagram, is shown to be accomplished using a shear transformation followed by translational and rotational operations applied to polygons representing respectively even and odd numbers of reflections within the section. The reflected neutron polygons are then truncated leaving only the neutrons that never strike a surface at an angle greater than the critical angle for total reflection. 4 refs., 4 figs.

52001 (LA-UR–89-2920, pp. 8, Paper 73) **Neutron beam handling by inelastic interaction with time-dependent magnetic fields.** Niel, L. (Atominsitut der Oesterreichischen Universitaeten, Wien (Austria)); Badurek, G.; Rauch, H.; Summhammer, J.; Weinfurter, H. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

Two different methods of energy transfer to neutrons by time-dependent magnetic fields are experimentally demonstrated. The first method involves a change of the neutrons potential energy during the passage through the field region. The second method involves a change of the neutrons potential energy during the passage through the field region. The second method involves a spin-flip in an external magnetic field by an rf-flipping device. All experiments were performed on high-resolution perfect crystal spectrometers. Applications of these methods for active monochromatization and beam handling are discussed. 18 refs., 6 figs.

52002 (LA-UR–89-2920, pp. 5, Paper 74) **SINQ guide concept.** Anderson, I. (Paul Scherrer Institute, Villigen (Switzerland)); Atchison, F. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

In this paper the authors describe the present concept for the layout of the neutron guides at SINQ. The characteristics of the source will make it particularly competitive in the cold neutron region through the inclusion of a liquid D_2. However, concommittant with the cold neutron production there will be high energy neutrons (E > 15 MeV) emitted from the source, which significantly influence many of the design parameters and, in particular, the required shielding. The guide system, although based on the demands for the foreseen instrumentation, has been designed to be as flexible as possible to allow reasonable future development, while taking into account the particular background problems arising from the high-energy neutrons. 3 refs., 2 figs., 2 tab.

52003 (LA-UR–89-2920, pp. 6, Paper 75) **Neutron beam compressors for pulse width reduction.** Lechner, R.E. (Hahn-Meitner-Institut, Berlin (Germany, F.R.)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

In the context of intensity and resolution optimization of a neutron time-of-flight spectrometer several methods of beam width reduction at the chopper are considered aiming at a reduction of the neutron pulse width at minimum loss of intensity. The most advantageous technique discussed uses a double-trumpet arrangement in which the chopper is placed in between converging and diverging neutron guide sections. 7 refs., 1 fig.

52004 (LA-UR–89-2920, pp. 4, Paper 76) **Summary of the recent conference on thin-film neutron optical devices.** Majkrzak, C.F. (National Institute of Standards and Technology, Gaithersburg, MD (USA)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The proceedings of the conference of the International Society for Optical Engineering on Thin-Film Neutron Optical Devices: Mirrors, Supermirrors, Multilayer Monochromators, Polarizers and Beam Guides, which was held in San Diego, California in August, 1988, are summarized here. 2 refs.

52005 (LA-UR–89-2920, pp. 4, Paper 77) **Neutron spectrum measurement, LANSCE/ER-1.** Howe, M.L. (Los Alamos National Lab., NM (USA)); Mundis, R.L. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

Neutron spectral measurements were made in LANSCE Experimental Room 1 during an intentional spill of 100 nA on a carbon block in the beam channel. The relative response of two neutron dosimetry badges and a neutron survey meter were investigated. The resultant neutron spectrum had a strong high-energy component containing 25% of the flux density and 70% of the neutron dose equivalent. The dosimetry badges and the survey meter underresponded by 80, 20 and 50%, respectively. Due to their individual energy responses, a simple sum of the two dosimeter results gives a total dose equivalent, which is close enough to the unfolded spectrum value to be used for personnel dosimetry records. 2 figs., 2 tabs.

52006 (LA-UR–89-2920, pp. 5, Paper 78) **The ISIS target halo monitors.** Carne, A. (Rutherford-Appleton Laboratory, Oxon (England)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The first ISIS target halo monitor was installed in July 1985 and was located some 360 mm in front of the input beam window of the target. It was provided because there was concern with the size and alignment of the extracted proton beam impacting the target. For an expected proton beam spot on target of parabolic intensity distribution of base 70 mm, the halo monitor diameter was 80 mm. Of the possible electrical or mechanical devices considered, a simple passive system was chosen of an annulus of metal intercepting the beam halo. The annulus was thermally isolated and used reactor-grade thermocouples to measure temperatures. In action the halo monitor was rather sluggish with slow rise and fall times and with a slow scanning speed. A new halo monitor was built and installed in March 1988 to overcome the limitations of the first. In the initial construction of the Target Station the target center was located well within a sphere of radius 1/2 mm and the center line lay within a cylinder of 1/2 mm radius. The proton beam alignment tolerance was sought at plus of minus 2 mm. After several years operation the alignment of the target relative to the EBP or the neutron beams is no longer known. Starting with target number 5, the author proposed to install a proton-beam monitor within the target itself which will be used with external monitors to define the target alignment.

52007 (LA-UR–89-2920, pp. 6, Paper 80) **Summaries and future projections.** Egelstaff, P.A. (Univ. of Guelph, Ontario (Canada)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

In this paper the author gives a brief summary of this meeting. He discusses the status at the current neutron sources and future sources. The current problems with targets, moderators, performance of storage rings and shields are briefly mentioned. Finally, he speculates on the prospects of neutron sources for the future and gives his version of the ultimate source.

52008 (LA-UR–89-2920, pp. 16, Paper 1) **ISIS status report.** Finney, J.L. (Rutherford-Appleton Laboratory, Oxon (England)); Gray, D.A. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The authors review the progress on ISIS, the pulsed neutron source at the Rutherford-Appleton Laboratory, since the last ICANS meeting. The machine is now running regularly at 100 μA at 750 MeV, and delivering neutrons for an increasing UK and international neutron scattering program. The current status of the operating and development instruments is summarized, and some examples given of recent science. 3 refs., 11 figs., 3 tabs.

52009 (LA-UR–89-2920, pp. 19, Paper 2) **Status of the intense pulsed neutron source.** Brown, B.S. (Argonne National Laboratory, IL (USA)); Carpenter, J.M.; Crawford, R.K.; Rauchas, A.V.; Schulke, A.W.; Worlton, T.G. Los Alamos National Lab., NM (USA). Mar 1989. DOE Contract W-31-109-ENG-38. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

Since 1981 the average proton currents at IPNS has increased substantially. The reliability has averaged 91%. The moderator has changed from a room temperature polyethylene to cryogenic methane. This report details progress made at IPNS (Intense Pulsed Neutron Source) during the last two years. The topics discussed are the operating status of the accelerator systems, other accelerator activities (such as, IPNS participation in SDI), instrumentation operating at IPNS, chopper development at IPNS, data acquisition, Booster target, moderators and examples of recent scientific results. The ever increasing instrument capability, the Booster target and the very active involvement with the scientific user community guarantees a productive scientific future at IPNS. 9 figs., 3 tabs.

52010 (LA-UR–89-2920, pp. 6, Paper 3) **Recent progress at LANSCE (Los Alamos Neutron Scattering Center).** Pynn, R. (Los Alamos National Laboratory, NM (USA)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

Since the ICANS meeting in 1986, a new construction project has been started at the Los Alamos Neutron Scattering Center (LANSCE). This project comprises an experimental hall, a support building which includes laboratories and offices, and four new spectrometers. The four instruments included in the project are a medium resolution powder diffractometer (NPD), a reflectrometer, a chopper spectrometer with a Brillouin scattering option, and a back-scattering spectrometer. The first incarnation of the NPD was installed in Aug.

of this year and has been found to have the predicted resolution. First measurements have been made with the prototype reflectrometer. Although the instrument will be in regular use form 1989 onwards, it will not be included fully in the users program until 1990. Detailed design is already in progress for the chopper spectrometer. The last of the four instruments, the back-scattering spectrometer, has been designed conceptually but not in detail. Part of the construction involves making four additional penetrations in the existing bulk-shield and bringing the beams into the new experimental hall. The penetrations will be made next year, but upgraded and new moderators will not be installed until 1991 or 1992. This year was the first year a formal users program was run. Unfortunately statistics for beam availability were unimpressive this year. 4 figs.

52011 (LA-UR–89-2920, pp. 14, Paper 4) **Progress at the pulsed-spallation neutron facility KENS.** Watanabe, N. (National Laboratory for High Energy Physics, Ibaraki (Japan)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The world's smallest pulsed-spallation neutron facility KENS is still active and has been successfully operated since the last ICANS with increasing proton-beam intensity. Scientist of the proton accelerator group at KEK have convinced themselves that a beam intensity of 2 x 10 to the 12th protons per pulse come within range. The beam time allocated to neutron-scattering experiments was about 1150 hours per year. Visiting scientists spent about 3500 man-days at the KENS facility last year. The neutron-production-target system of depleted uranium has worked quite well with great stability. It was recently found that the polyethylene moderator at room temperature suffered from radiation damage. Therefore polyethylene was replaced with circulating light water. Installation of the new moderator system was completed in 1988. Some improvements have been performed on the hardware of the KENS cold neutron source. In the KENS facility there are sixteen neutron scattering instruments: fourteen are in operation, a chopper spectrometer INC is under construction, and an ultra cold neutron generator test UCN is still under development. A new data acquisition and processing system based on the VAX has been installed. Activities in neutron scattering are also discussed in this paper. 14 refs., 12 figs., 2 tabs.

52012 (LA-UR–89-2920, pp. 32, Paper 7) **The proton storage ring: Problems and solutions.** Macek, R.J. (Los Alamos National Laboratory, NM (USA)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The Los Alamos Proton Storage Ring (PSR) now operates with 35μA at 20-Hz pulse repetition rate. Beam availability during 1988 suffered because of a number of problems with hardware reliability and from narrow operating margins for beam spill in the extraction line. A strong effort is underway to improve reliability with an eventual goal of obtaining beam availability in excess of 75%. Beam losses and the resulting component activation have limited operating currents to their present values. In detail studies of the problem, loss rates were found to be approximately proportional to the circulating current and can be understood by a detailed accounting of emittance growth in the two-step injection process along with Coulomb scattering of the stored beam during multiple traversals of the injection foil. It is now apparent that the key to reducing losses is in reducing the number of foil traversals. A program of upgrades to reduce losses and improve the operating current is being planned. 8 refs., 17 figs., 2 tabs.

52013 (LA-UR–89-2920, pp. 26, Paper 14) **Opportunities for research program development at LANSCE (Los Alamos Neutron Scattering Center.** Bowman, C.D. (Los Alamos National Lab., NM (USA)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The availability of intense neutron beams from facilities associated with the Proton Storage Ring and LANSCE has stimulated the development of neutron research well beyond the mainstream of neutron scattering. A description of this extended program is given along with prospects for further growth. 23 refs., 11 figs., 4 tabs.

52014 (LA-UR–89-2920, pp. 8, Paper 17) **The ASPUN project.** Kustom, R.L. (Argonne National Lab., IL (USA)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

A study of a pulsed spallation neutron source that could deliver fluxes in excess of 1 x 10^{17} N/cm^2-s began at Argonne in 1981. A review of various accelerator concepts to act as an intense charged-particle source to generate spallation neutrons resulted in the selection of a Fixed-Field Alternating-Gradient (FFAG) accelerator as the preferred device. There are several features of an FFAG accelerator that make it well suited to be the charged-particle accelerator for a 10^{17} N/cm^2-s pulsed source. Since the main magnets are dc operated, injection time can be long enough to provide for efficient injection and adiabatic capture, the rf system can be optimized for maximum use of the accelerating voltage, the repetition rate can reach hundreds of hertz because there are no dB/dt effects in the magnets or vacuum chamber, and large transverse and momentum acceptances are possible. The large momentum acceptance and rapid acceleration helps avoid some of the instability problems. The conceptual design has evolved from a spiral-type FFAG with strong edge focusing to a radial-type FFAG. The radial-type FFAG allows easier installation of the rf cavities at the expense of higher magnetic fields. Since the magnets are dc operated, the higher field can be achieved with superconducting coils. 10 refs., 6 figs., 1 tab.

52015 (LA-UR–89-2920, pp. 15, Paper 20) **On the kinematics and resolution of spectrometers for neutron Brillouin scattering.** Robinson, R.A. (Los Alamos National Lab., NM (USA)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

Neutron Brillouin scattering involves measurement of excitations at smaller Q values than is currently customary. The author outlines the kinematic constraints on scattering angle and incident energy for excitations with both linear dispersion (sound waves) and parabolic dispersion (ferromagnetic spin waves), and discuss the resolution characteristics of the chopper spectrometer proposed for LANSCE which should be suitable for such studies. In particular, he demonstrates that longitudinal resolution focusing can be exploited both in neutron energy gain and in neutron energy loss. 13 refs., 10 figs., 1 tab.

52016 (LA-UR–89-2920, pp. 13, Paper 22) **The effects of chopper jitter on the time-dependent intensity transmitted by multiple-slot multiple disk chopper systems.** Copley, J.R.D. (Univ. of Maryland, College Park (USA)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The author presents Monte Carlo calculations of the time dependence of the intensity transmitted by single- and multiple-slot multiple disk chopper assemblies, taking into account the effects of chopper jitter. In the case of multiple-slot systems, where each of at least two choppers and a mask is fitted with two or more slots, a switching function is employed to suppress contaminated pulses, i.e., pulses in which neutrons can pass through slots that would never line up in the absence of jitter. Such pulses, if accepted, would degrade the time resolution of the system. His results for the time-integrated intensity are in good agreement with previously reported

semi-analytic calculations. The need to reject contaminated pulses in multiple-slot systems is emphasized. 5 refs., 6 figs., 2 tabs.

52017 (LA-UR–89-2920, pp. 8, Paper 26) **Recent results with the Los Alamos Constant-Q spectrometer.** Yethiraj, M. (Los Alamos National Lab., NM (USA)); Robinson, R.A. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The Constant-Q geometry for measuring collective excitations on pulsed-neutron sources was proposed and tested by Windsor et al., in 1978. By 1985, a second improved Constand-Q spectrometer had been built at Los Alamos, and improvements over Windsor's version were listed in a previous ICANS proceeding. In this article, the authors list further improvements made to the Los Alamos spectrometer and give a brief account of other progress on it. 8 refs., 8 figs.

52018 (LA-UR–89-2920, pp. 24, Paper 32) **GLAD: The IPNS (Intense Pulsed Neutron Source) Glass, Liquid, and Amorphous materials Diffractometer.** Crawford, R.K. (Argonne National Lab., IL (USA)); Price, D.L.; Haumann, J.R.; Kleb, R.; Montague, D.G.; Carpenter, J.M.; Susman, S.; Dejus, R.J. Los Alamos National Lab., NM (USA). Mar 1989. DOE Contract W-31-109-ENG-38. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

A number of years of experience in diffraction from amorphous materials has now been accumulated at various pulsed neutron sources. Workshops t IPNS and elsewhere have distilled some of this experience to provide a set of criteria for a new diffractometer dedicated to an optimized for structural studies of amorphous materials. This paper discusses the instrument GLAD (Glass, Liquid, and Amorphous Materials Diffractometer) which has been designed to meet these criteria and is now being built at IPNS. This instrument involves the use of relatively short-wavelength neutrons and a sophisticated neutron detection and acquisition system. A preliminary, simplified version of the instrument has been constructed while the final version is still under design, in order to develop the data acquisition and analysis techniques and to develop methods for collection of data with adequate quality (low background) at short wavelengths. This paper will briefly outline the final instrument envisioned and its calculated performance, but will focus mostly on the details of the detection/acquisition system and the calibration and data collection procedures which have been developed. The brief operating experience which has been gained to data with the preliminary instrument version will also be summarized. 6 refs., 12 figs.

52019 (LA-UR–89-2920, pp. 6, Paper 45) **A combined H_2/CH_4 cold moderator for a short pulsed neutron source.** Williamson, K.D. (Los Alamos National Lab., NM (USA)); Lucas, A.T. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

Both the ISIS (Rutherford-Appleton Laboratory) spallation source and the Los Alamos Neutron Scattering Center (LANSCE) were designed to produce neutrons as a result of an 800-MeV proton beam being incident on a target. Both systems are intended to accept beam intensities up to 200 μA. Cryogenic moderators of liquid hydrogen and methane are either in use or are planned for service at both facilities. Very low temperature methane would be an ideal moderating material as it has a high hydrogen density and many low frequency modes, which facilitate thermalization. Such moderators are in service at two major world facilities, KEK (Japan) and Argonne National Laboratory (USA). Unfortunately, solid methane has very low thermal conductivity and is subject to radiation damage making a moderator of this type impractical for use in high-intensity beam, such as indicated above. This report outlines a possible alternative using small spheres of solid methane in a matrix of supercritical hydrogen at 25 K. 4 figs.

52020 (LA-UR–89-2920, pp. 2, Paper 53) **Summary of contribution to the ICANS-X panel discussion.** Dolling, G. (Atomic Energy of Canada Limited, Chalk River, Ontario). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The author's role on this panel was to represent that group of users who wish to measure $S(Q\rightarrow,\omega)$ at specified, pre-selected values of $Q\rightarrow$ and ω. Until now this kind of measurement has always been reasonably easy to do with a triple axis crystal spectrometer (TACS) at a continuous source of neutrons, and rather more difficult to do with a time-of-flight (TOF) machine at a pulsed source. Only those physicists who were extraordinarily hard-working and persistent managed to get any useful specific $s(Q,\omega)$ data, using TOF methods. The lazy physicist simply emigrated to a place where triple axis spectrometers were located, or where he could build new ones. It has not so far been feasible to use a conventional TACS at a pulsed neutron source because there is insufficient time-averaged intensity. The pulsed source user is obliged to use TOF methods, so naturally there has been much effort devoted to making it possible to do specific (Q,ω) measurements with a TOF spectrometer. One of the better examples along these lines if right here at Los Alamos-the Constant Q Spectrometer; PRISMA at ISIS is another excellent example. There are, however, significant limitations to the flexibility of these instruments. It seems likely that they will not be capable of supplanting the conventional TACS for a substantial body of fundamental research work.

52021 (LA-UR–89-2920, pp. 1, Paper 56) **Summary of contribution to the ICANS-X panel discussion.** Taylor, A.D. (Rutherford Appleton Laboratory, Oxon (England)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

Users are a nuisance, but they are essential to ensure the long-term funding and optimum utilization of research facilities as expensive as advanced neutron sources. The typical user wants ten times more flux, ten times better resolution and ten times more beam time. But the history of neutron scattering shows that advances are instrument-let rather than science-led. This is perhaps inevitable in a field such as condensed matter studies where neutron scattering is but one (albeit a very important one) of the techniques available. The current generation of accelerator-based pulsed neutron sources represent one such major advance giving significant improvements in resolution (from the sharpness of the pulses) and signal-to-noise (from the time discrimination of fast and thermal neutron). Source reliability at greater than the 80% level is essential for efficient scheduling of a user program, and that has now been shown to be achievable. Powerful computing tools are also essential to allow the user to extract the meaningful information from the deluge of data, and these will continue to be developed in a user friendly way. For the next generation neutron source, the newly discovered advantages of the high resolution, sharp pulse spallation sources should be combined with the experience built up over the years on steady state sources. The SDI program has shown that the current generation of accelerators are nowhere near their technological limit. A relatively modest increase in proton current, to say 1-2 mA, would not only boost the performance of traditional time-of-flight instruments but also give sufficient flux from an unpoisoned moderator to compete effectively as a steady state source whilst retaining all the advantages of a pulsed source. Incorporation of time discrimination for order and background suppression on a triple-axis crystal spectrometer is a truly exciting prospect.

52022 (LA-UR–89-2920, pp. 18, Paper 57) **Advanced spallation sources; scientific opportunities and technical feasibility.** Bauer, G.S. (Paul Scherrer Institute, Villigen (Switzerland)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron*

sources. Order Number DE89016602. Available from NTIS, PC A99/MF A01.

In order to meet with the growing demands both for neutron scattering facilities as such and for more sophisticated experiments to obtain more detailed and clear cut information, a new generation of neutron sources is necessary which allows optimum use of the neutrons produced to give enough intensity for very high resolution work as well as for the investigation of phenomena with very low signal rates. Spallation neutron sources with a short primary neutron pulse and flexibly designed fast as well as coupled moderators together with a variety of imminent new phase space handling techniques have a prospect of satisfying the scientific needs also in the future. They are technically feasible both on the part of accelerators, which have not been dealt with in this paper and on the part of target systems, where new design routes can be followed. 9 refs., 2 figs., 1 tab.

52023 (LA-UR–89-2920, pp. 17, Paper 59) **Progress report on measurement and fitting of pulse shapes of moderators at IPNS (Intense Pulsed Neutron Source).** Bywater, R.L. Jr. (Iowa State Univ., Ames (USA)); Williams, R.E.; Carpenter, J.M. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

The authors present a progress report on measurements and fitting of pulse shapes for neutrons emerging from one solid and two liquid methane moderators in IPNS. A time-focused crystal spectrometer arrangement was used with a cooled Ge monochromator. Data analysis of one of the liquid methane moderators has shown the need for some generalization of the Ikeda-Carpenter function that worked well for fitting pulse shapes of polyethylene moderators. They describe attempts to model physical insight into the wavelength dependence of function parameters. 5 refs., 7 figs.

52024 (LA-UR–89-2920, pp. 26, Paper 61) **The performance of maximum entropy methods in spectral deconvolution.** Johnson, M.W. (Rutherford-Appleton Laboratory, Oxon (England)); Lister, J. Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

There have been a number of previous demonstrations of the use of the Maximum Entropy principle (MaxEnt) in the deconvolution of experimental spectra. However, as far as is known, there have been no previous discussions of the problems that arise in applying MaxEnt methods in practice. When deconvoluting a known, model spectrum it is straightforward to show, by means of an R-factor, that you have reached good agreement with the intrinsic spectrum. When deconvoluting real data the experimentalist derives a result, but then does not know how much credence to place on the result. The question what are the error bars is not appropriate since the errors on a deconvoluted spectrum are not uncorrelated, but the spirit of the question is valid. This paper addresses itself to that problem. The approach is purely pragmatic. In the first section the authors show the results of deconvoluting a Gaussian line shape from three different intrinsic line shapes. In the second section the procedure is repeated for doublet intrinsic peaks, and the criteria for separation established. In the third section they demonstrate that line shapes other than Gaussian may be removed from broadened spectra and examine the effects of uncertainties in the knowledge of the broadening function. 4 refs., 19 figs., 3 tabs.

52025 (LA-UR–89-2920, pp. 10, Paper 79) **Summary of the Los Alamos Spallation Radiation Effects Facility at LAMPF (LASREF).** Sommer, W. (Los Alamos National Lab., NM (USA)). Los Alamos National Lab., NM (USA). Mar 1989. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), Los Alamos, NM (USA), 3-7 Oct 1988). In *Proceedings of the 10th meeting of the international collaboration on advanced neutron sources.* Order Number DE89016602. Available from NTIS, PC A99/MF A01.

This paper describes the components and procedures in place at LASREF. It also lists the irradiation experiments performed. Active experiments, major results, and future plans are briefly described. The papers covering theoretical aspects, facility characterization/description and experiments at LASREF are listed.

52026 (ORNL/FTR–2475) **[Research on neutron sources]: Foreign trip report, December 15–16, 1986.** Flanagan, C.A. Oak Ridge National Lab., TN (USA). 30 Dec 1986. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89017290. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Institut Laue-Langevin is a fundamental research institute providing a source of neutrons for a variety of basic experiments ranging from basic physics to biology, solid state physics, and chemistry. The reactor operates at a power level of 57 MW(th) and provides a maximum thermal neutron flux of 1.2×10^{15} n/cm^2/s. Cooling and moderation are by heavy water. Neutron beams are available from sources of hot, thermal, and "cold" beam ports. At present, ILL has one cold neutron source (25 dm^3 liquid deuterium at 25 K); a second cold source is to be installed in 1987. The ILL has operated successfully since late 1971. Discussions during this visit centered on reactor operations, particularly fuel element replacement and the associated engineering and safety considerations, and the design considerations associated with cold sources.

52027 (ORNL/FTR–2499) **[Advanced neutron source research]: Foreign trip report, February 7–21, 1987.** West, C.D. Oak Ridge National Lab., TN (USA). 24 Feb 1987. 14p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89017298. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The ILL is an international laboratory providing to its users the world's best facilities for neutron research, the main emphasis being on neutron scattering experiments in solid state physics, biology, chemistry and basic physics. The facility is superb, providing powerful sources of hot, thermal, cold, and ultra-cold neutrons. The Technischen Universitat Munchen, Bavaria, has an old 4 MW research reactor, the first to operate in Germany, and has devoted extensive efforts to the development and improvement of experimental equipment and techniques for neutron research, including an ultra-cold neutron source, neutron guides and various innovative spectrometers. A new cold source is presently being installed.

0703 Isotopic Power Supplies

52028 (N–89-23518) **Preliminary assessment of rover power systems for the Mars Rover Sample Return Mission.** Bents, D.J. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1989. 26p. (NASA-TM–102003;E–4707;NAS–1.15:102003;CONF-8906169–: International Astronautics Federation conference on space power, Cleveland, OH (USA), 5-7 Jun 1989). Available from NTIS, PC A03/MF A01.

Four isotope power system concepts were presented and compared on a common basis for application to on-board electrical prime power for an autonomous planetary rover vehicle. A representative design point corresponding to the Mars Rover Sample Return (MRSR) preliminary mission requirements (500 W) was selected for comparison purposes. All systems concepts utilize the General Purpose Heat Source (GPHS) isotope heat source developed by DOE. Two of the concepts employ thermoelectric (TE) conversion: one using the GPHS Radioisotope Thermoelectric Generator (RTG) used as a reference case, the other using an advanced RTG with improved thermoelectric materials. The other two concepts employed are dynamic isotope power systems (DIPS): one using a closed Brayton cycle (CBC) turboalternator, and the other using a free piston Stirling cycle engine/linear alternator (FPSE) with integrated heat source/heater head. Near term technology levels have been assumed for concept charactarization using component technology figure-of-merit values taken from the published literature. For example, the CBC characterization draws from the historical test database accumulated from space Brayton cycle subsystems and components from the NASA B engine through the mini-Brayton rotating unit. TE system performance is estimated from Voyager/multihundred Watt (MHW)-RTG flight experience through

Mod-RTG performance estimates considering recent advances in TE materials under the DOD/DOE/NASA SP-100 and NASA Committee on Scientific and Technological Information programs. The Stirling DIPS system is characterized from scaled-down Space Power Demonstrator Engine (SPDE) data using the GPHS directly incorporated into the heater head.

08 HYDROGEN

0801 Production

Refer also to citation(s) 51649, 52032

52029 (PB–89-197370/XAB) **Innovation in photoelectrodes for the splitting of water.** Lindmayer, J. Quantex Corp., Rockville, MD (USA). 15 Oct 1986. 18p. Available from NTIS, PC A03/MF A01.

Generation of hydrogen from a renewable energy source is highly desirable because hydrogen is a basic fuel. Past work has shown that certain semiconductor electrodes will generate hydrogen directly upon illumination; however, the efficiency of such systems is low. This work explored an idea based on a 'hot electron gun' where freshly generated hot electrons are made to interact with water. The work attempted to show, through the use of three semiconductors (germanium, gallium arsenide, and silicon), that hot electrons could be tunneled into the electrolyte. Numerous thin metals were used to form a tunneling interface. Particularly interesting results were obtained with a titanium-palladium double layer and with indium-tin oxide. The presence of hot-electron activity was detected and the threshold voltage for hydrogen generation was reduced to below half a volt.

0805 Safety

Refer also to citation(s) 52341

0808 Properties

52030 (N–89-24445) **A premixed hydrogen/oxygen catalytic igniter.** Green, J.M. Sverdrup Technology, Inc., Cleveland, OH (USA). Jun 1989. 9p. (NASA-CR–185113;E–4787;NAS–1.26:185113;AIAA–89-2302;CONF-8907118–: 25. American Society of Mechanical Engineers joint propulsion conference, Monterey, CA (USA), 10-13 Jul 1989). Available from NTIS, PC A02/MF A01.

Final Report; cosponsored by the AIAA, ASME, SAE and ASEE.

The catalytic ignition of hydrogen and oxygen propellants was studied using a premixing hydrogen/oxygen injector. The premixed injector was designed to eliminate problems associated with catalytic ignition caused by poor propellant mixing in the catalyst bed. Mixture ratio, mass flow rate, and propellant inlet temperature were varied parametrically in testing, and a pulse mode life test of the igniter was conducted. The results of the tests showed that the premixed injector eliminated flame flashback in the reactor and increased the life of the igniter significantly. The results of the experimental program and a comparison with data collected in a previous program are given.

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

Refer also to citation(s) 52422, 52506, 52848

52031 (AD-A–209572/7/XAB) **Characterization of methanogen membrane function: A genetic approach. Final report, August 1986-July 1989.** Santoro, D.K. Illinois Univ., Urbana, IL (USA). Dept. of Microbiology. 22 Jun 1989. 80p. Available from NTIS, PC A05/MF A01.

Methanococcus voltae is a marine methanogen which derives its energy from reactions derived from the reduction of carbon dioxide by hydrogen. The author is interested in elucidating basic principles of energetics in this archaebacterium and has focused on active transport, ion-translocation pathways, and ATP generating systems. Significant progress has been made in the elucidation and characterization of a novel P-type ATPase in this organism. The enzyme has been purified and partially characterized, and the formation of an acyl phosphate intermediate demonstrated in its catalytic sequence. An active transport system has been discovered for HS-CoM, a novel methanogen coenzyme involved in a terminal step of methanogenesis. Mutants altered in this active transport system have been isolated and characterized.

52032 (BNL–42124) **The conversion of carbonaceous materials to clean carbon and co-product gaseous fuel.** Steinberg, M. Brookhaven National Lab., Upton, NY (USA). Aug 1989. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-891034–1: 5. European conference on biomass for energy and industry, Lisbon (Portugal), 9-13 Oct 1989). Order Number DE90001561. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A new process has been developed for converting raw carbonaceous materials to clean carbon fuels and coproduct clean gaseous fuel. The process is unique and universal in terms of dealing with all carbon containing raw materials. The process, called HYDROCARB, consists of two basic steps. The raw carbonaceous material is first hydropyrolyzed in an atmosphere of an excess of hydrogen so as to form methane. Any solid ash remains behind in the hydropyrolyzer. This step is then followed by the thermal decomposition of the methane by pyrolysis to carbon black and hydrogen. The hydrogen is then recycled to the first step to repeat the cycle. The excess hydrogen then becomes a coproduct fuel. Using a downflow dense phase media in a moving bed reactor, the exothermic heat in the hydrogenation reaction is used for providing the endothermic heat in the methane pyrolysis step. Thus, the energy and mass efficiency of the process can be very high (approximately 90%). The feedstock from the process can be any carbonaceous material including coal, biomass (wood) and agricultural and municipal solid waste. Depending on the scale of the process economic estimates indicate that as a fuel, the clean carbon produced by the HYDROCARB Process can compete with today's price for oil. The following indicates the value of clean carbon as a fuel: (1) all environmental impurities have been removed; it is sulfur- and ash-free, (2) it is an energy-dense fuel, assuming wood as a feedstock having a heating value of typically 10 million Btu/ton of wood can be upgraded to 28 million Btu/ton of carbon, and (3) the carbon can be slurried with water, methanol, and other conventional hydrocarbon fuels; in slurry form, it can be used in heat engines such as turbines and diesel engines. 3 refs., 2 figs., 5 tab.

52033 (NEDOJ–8809 vp) **Development of methane gas production facility combined with high efficiency separation film. Development of high-efficiency module.** Yoshino, Akira (TOTO Ltd., Kitakyushu (Japan)). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the 8th NEDO General Assembly.* Available from NTIS (US Sales Only), PC A23/MF A01.

The objective of this project is to maintain high concentration of bacteria in the reactor by the combination of methane fermentation and film separation technologies for effective methane fermentation. The target of the development is to develop a compact tube type ceramic film module of internal pressure type suitable for maintaining high concentration of undecomposed organic materials to satisfy the established power consumption rate. The film module and the performance of the film were compared with the operational methods of single phase liquid fluid system, liquid-solid 2 phase fluid system, and gas-liquid-solid 3 phase fluid system. The film processing system utilizing natural circulation of gas-liquid fluid system was found to be the best in film permeation, power consumption rate, and phase separation. However, there are many problems left for solution, such as study on the characteristics as the biocreator in a long term continuous operation, solution for the foaming of treated liquid at the time of gas supply, and improvement in permeation by phase distribution of gas-liquid 2 phase fluid and fluid mode control. 2 references, 22 figures, 3 tables.

52034 (NEDOJ–8809, pp. 373-377) **Outline of alcohol biomass technological development.** Matsuo, Tsugio (New Energy

Development Onganization, Tokyo (Japan)). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the 8th NEDO General Assembly.* Available from NTIS (US Sales Only), PC A23/MF A01.

In the field of the alcohol biomass technology, projects are being carried on for the Technological Develpment of Fuel Alcohol, Development of Methane Gas Production Equipment combined with High Efficiency Separation Film, and Verification Test of Methanol Conversion at Petroleum Thermal Power Plant, etc. As to the technological development of fuel alcohol, the target is the development of a new technology for alcohol production by bacteria which will enable efficient alcohol fermentation directly from the unused resources of agriculture and forest waste. In the development of methane production equipment combined with high efficiency separation film, development of film module for methane fermentation, new bioreactor for methane fermentation, measurement control system for methane fermentation, etc. were carried out. As regards verification test of methanol conversion at petroleum thermal power plant, development of catalysts for methanol upgrading, development of thermal recovery/reaction system, and development of combustor, and study and evaluation of reserch on elements were performed. The study plan for each project for 1988 is reported.

52035 (NEDOJ–8809, pp. 420-435) **Development of methane gas production facility combined with high efficiency separation film. Development of high-efficiency bioreactor.** Minami, Kiyoshi (Simizu Construction Co., Ltd., Tokyo (Japan)). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the 8th NEDO General Assembly.* Available from NTIS (US Sales Only), PC A23/MF A01.

A report is made on the development of a Fixed Bed Type Bioreator for Medium-to-HighCconcentration Waste Water to be used as the combined methane production equipment using high efficiency separation film. The actual waste water experiments using a 2001 bio-reactor combined with separation film showed that very high efficient opeation is possible as compared with the case where no separation film is employed, with the result of 14.4 g/√day TOC load per unit volume under the condition of 80% removal rate. It was confirmed that operation with BOD load of 45 g√BOD/1√day is possible. This indicates that it has 20 - 30 times of processing capacity as compared with the activated sludge processing. It can be expected that waste water treatment which required wide space up to now may be performed in a relatively small space. However, there are still many problems left, such as effect of the H_2S generation by the existence of sulfuric acid reducing bacteria on methane fermentation, residual materials such as acetic acid, propionic acid, etc. 16 references, 7 figures, 6 tables.

52036 Thermochemical gasification of wet biomass and wastes. Butner, R.S.; Elliott, D.C.; Sealock, L.J. Jr.; Neuenschwander, G.G. 18p. American Institute of Chemical Engineers, New York, NY (1988). (CONF-880348--: American Institute of Chemical Engineers spring national meeting, New Orleans, LA (USA), 6-10 Mar 1988).

Technical Paper 17D.

Pacific Northwest Laboratory has been conducting laboratory research on the low-temperature (under 450°C) gasification of biomass and biomass model compounds for several years. Work in this area has been carried out for both the Gas Research Institute and the U.S. Department of Energy (DOE) Division of Biofuels and Municipal Waste Technology. One of the main thrusts in this work has been to investigate the role of selected catalysts at high water-to-biomass ratios (typically in excess of 9:1 by weight). A 1-liter batch reactor has employed to obtain overall gas yield and composition data, along with limited information regarding the actual rate of gas production. These batch studies have clearly demonstrated the utility of the concept, in which high-moisture slurries up to 95 wt% moisture of various biomass feedstocks have been gasified at high carbon conversion to gas at temperatures as low as 380°C.

0902 Alcohol Fuels

Refer also to citation(s) 51642, 51643, 52034, 52422

52037 (Juel-Conf–64, pp. 26-40) **Energy alcohols as fuels.** Broeckerhoff, P. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente. Sep 1988. (In German). In *Working report of the Institute of Reactor Components at the KFA Juelich. Scientific lectures of the commemorative colloquium held on September 2, 1987 at the KFA Juelich.* Order Number DE90711187. Available from NTIS (US Sales Only), PC A06/MF A01.

Combustion experiments were performed with methanol, and the resulting waste gases were analyzed. A radiant burner was developed along with these experiments. After numerous experiments with various catalyst supports, it became clear, during the operation of the radiant burner, that fibrous supports with directly applied platinum are suitable. (EF).

52038 (NEDOJ–8809, pp. 378-384) **Development of technology for fuel alcohol. Search and breeding of superior bacteria.** Uchida, Masahiro (Takara Shuzo Co., Ltd., Kyoto (Japan)). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the 8th NEDO General Assembly.* Available from NTIS (US Sales Only), PC A23/MF A01.

For the purpose of developing production technology for practical fuel alcohol, technology is being pursued for the conversion to ethanol directly from lumber components by anaerobic bacteria under high temperature anaerobic condition. In 1987, studies were continued from the viewpoints of cultural engineering and genetic engineering, and bacteria sources from the soil in hot sprint areas, compost, etc. were searched for. Thermophilic anacrobic cellulose fermenting bacteria were searched for, and the maximum ethanol concentration of 0.37w/v% was achieved from 2% cellulose substrate in 5 days by ethanol dipping/heat shock process. It was equivalent to 33% in the carbon recovery rate. 7 superior strains were obtained from the collected soil. 8 Sm resistance bacetria and 1 Cm resistance bacterium were obtained. Ethanol fermentation properties of superior bacteria and fermentation inhibiting factors were studied. For the breeding of superior bacteria, I-1-B strain was subjected to variation treatment. The result of the breeding by gene manipulation is also reported.

52039 (NEDOJ–8809, pp. 385-399) **Development of technology for fuel alcohol. Research and development for total system.** Yamada, Tomiaki (JGC Corp., Tokyo (Japan)). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the 8th NEDO General Assembly.* Available from NTIS (US Sales Only), PC A23/MF A01.

The objective of this technological development is the development of a total system for the production of alcohol, by the use of bacteria, directly from agriculture and forestry waste, especially unused forestry resources. Study on the optimum steam explosion conditions, explosion experiment by a small scale plant, fermentation evaluation test of the products made by explosion were carried out. When cryptomeria chip was treated for 10 minutes by steam explosion under saturated steam (250°C) of 40 kg/cm^2, the enzyme saccharification rate of the exploded wood reached 88%. After cellulose decomposition test, experiement for the study on the thermal decomposition characteristics of cryptomeria was performed. An improved exploder with the wood chip treating capacity of 4 kg/batch was installed to perform experiments. One step treatement of explosion only and 2-step treatment which is a combination of steam cooking and explosion were investigated. To evaluate exploded products as fermentation materials, fermentation test was performed to see the relationship between enzyme saccharification rate of exploded products and fermentation result by Clostridium. 15 references, 8 figures, 1 table.

52040 (NEDOJ–8809, pp. 436-455) **Development of methanol-upgrading-type power-generation technology. Development of elemental technology.** Baba, Susumu (The Chugoku Electric Power Co., Inc., Hiroshima (Japan)). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceeding of Parallel Sessions for the 8th NEDO General Assembly.* Available from NTIS (US Sales Only), PC A23/MF A01.

Research and development of elemental technologies were carried out for 3 years starting in 1985 to encourage the use of fuel methanol as an alternate energy for petroleum. The result of the

study at the end of the final year is reported. The subjects for the development were the development of high efficient and long life catalysts for methanol upgrading, development of optimum reactor and heat recovery system, development of combustion for gas upgrading, and study and evaluation of research on elements. Developments were made for catalysts having heterogeneous pore structures and homogeneous pore structures. Studies and experiments were made for the selection of optimum heat recovery/reaction systems, design for the establishment of technology to meet the requirement of DSS and load variation, and dynamic characteristics (simulation). Combustion characteristics and variable flow amount control mechanism were investigated. Conceptional design of a methanol reforming type power generation plant was worked out, and arranged by assumed scales of power generation. Study was made on the replacement of the existing thermal power generation sources. 14 figures, 3 tables.

52041 (PB–89-868590/XAB) **Alcohol fuels: Utilization. September 1985-August 1989 (Citations from the NTIS database). Report for September 1985-August 1989.** National Technical Information Service, Springfield, VA (USA). Aug 1989. 108p. Available from NTISPC N01/MF N01.

Supersedes PB–88-856109.

This bibliography contains citations concerning the utilization of alcohol fuels, including gasohol. The use of alcohol fuels in internal combustion engines, diesel engines, automobiles, trucks, and buses are among the topics discussed. Characterization of exhaust emissions from alcohol fuels, waste-heat recovery, and machinery endurance are included. Production of alcohol fuels is discussed in a separate bibliography. (This updated bibliography contains 185 citations, 50 of which are new entries to the previous edition.)

52042 Economics of enzymatic hydrolysis processes. Wright, J.D. 47p. American Institute of Chemical Engineers, New York, NY (1988). (CONF-880348–: American Institute of Chemical Engineers spring national meeting, New Orleans, LA (USA), 6-10 Mar 1988).

Technical Paper 17F.

Enzymatic hydrolysis processes have the ability to produce high yields of sugars for fermentation to fuel ethanol from lignocellulosic biomass. However, these systems have been plagued with yields, product concentrations, and reactions rates far below those that are theoretically possible. In this paper engineering and economic analyses are presented on several fungal enzyme hydrolysis processes to illustrate the effects of the important process parameters, to quantify the progress that has been made to date, and to estimate the cost reductions that can be made through research improvements.

0904 Solid Waste and Wood Fuels

Refer also to citation(s) 52508, 52509

52043 (PB–89-197321/XAB) **Electrochemically assisted pyrolysis of hardwoods.** Koch, V.R. Covalent Associates, Inc., Woburn, MA (USA). Aug 1986. 29p. Available from NTIS, PC A03/MF A01.

This project explored the low-temperature, electrochemically assisted pyrolysis of lignocellulosic material to low-molecular-weight organic chemicals. Through the agency of low temperature $AlCl_3$-based molten salts, aspen hardwood flour was reacted in $AlCl_3$:NaCl, $AlCl_3$:NaCl:KCl, and $AlCl_3$:BPC (n-butylpyridinium chloride) media at temperatures from 30-220 C. A wide variety of water soluble products were formed comprising CO, CO_2, keto-alcohols and low molecular weight phenolic compounds as determined by GC and FTIR spectroscopy. The compounds represented about 32% by weight of the aspen wood flour. Owing to the narrow (2 volt) electrochemical window versus an Al reference electrode, neither the wood flour nor the reaction products manifested any electro-activity. Authentic samples of cellulose, hemicellulose, and Klason lignin were also subjected to low temperature pyrolysis. Only the hemicellulose reacted to give CO_2 and keto-alcohols.

52044 The combustion of cellulosic char under laminar flow conditions. Smith, F.G. III; Pendarvis, R.W. 43p. American Institute of Chemical Engineers, New York, NY (1988). (CONF-880348–: American Institute of Chemical Engineers spring national meeting, New Orleans, LA (USA), 6-10 Mar 1988).

Technical Paper 45A.

An experimental and modeling study of cellulosic char combustion under laminar gas flow conditions was made covering the ranges of 473 to 1,173^{0}K and 0.03 and 0.21 oxygen mole fraction at ambient pressure. A gas film mass transport-limited model for flow parallel to a flat plate, modified to account for surface roughness, accurately fit the combustion rates observed in a thermogravimetric furnace.

0906 Gaseous Waste Fuels

52045 (EEO-ED–191/217) **Use of landfill gas as a replacement fuel in a shell boiler. A demonstration at Premier Brands Ltd. Merseyside.** Department of Energy, London (UK). Energy Efficiency Office; National Industrial Fuel Efficiency Services Ltd., Altrincham (UK). Feb 1988. 35p. Order Number DE90709246. Available from NTIS (US Sales Only), PC A03/MF A01.

Energy Efficiency Demonstration Scheme report for the Energy Technology Support Unit (ETSU), Harwell (GB).

The project, the first of its kind in the UK to extract methane from a mounded landfill site and fire the unrefined fuel in a Shell type steam boiler, has demonstrated that with a well-engineered installation the risk of interruption in the supply of landfill gas is small, and the gas can be successfully fired on conventional boilers without any major loss in efficiency. A total of 1.048 million therms (110 594 GJ) was consumed during 1986 which represented 61.2% of the total fuel used by the boiler plant. The capital cost of the project was Pound 140 743. The simple pay-back periods were from 6.6 years (at 10% discount on the cost of interruptible natural gas) to 3.0 years (at 20% discount). Tests over the 12 month period have shown no evidence of enhanced corrosion and comparison between landfill and natural gas firing has shown no significant difference. Polycyclic aromatic hydrocarbons were not detected in the boiler flue gases and other components of the products of combustion differed little from natural gas which is accepted as a cleaner and environmentally more acceptable fuel than oils and coal. (author).

13 HYDRO ENERGY

1301 Resources and Availability

52046 (ORNL/FTR–3419) **[Pre-feasibility analysis of a small hydroelectric project site]: Foreign trip report, September 25–October 7, 1989.** Waddle, D.B. Oak Ridge National Lab., TN (USA). 16 Oct 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90001295. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

I arrived in San Jose on September 25, 1989, to perform a pre-feasibility analysis of a small hydroelectric project site for a newly formed consortium of rural electric cooperatives. Site analysis included hydrologic analysis, soils and geologic analysis, route evaluations, and cost and power sales benefit analyses. The study was performed in collaboration with the National Rural Electric Cooperative Association (NRECA), sponsored by the Agency for International Development (AID) through the Renewable Energy Applications and Training project, implemented by Oak Ridge National Laboratory (ORNL). I was in Costa Rica for a two week period to manage and coordinate the project development activities with the consortium assistance team, who were in Costa Rica during the same period of time.

1302 Site Geology and Meteorology

Refer also to citation(s) 52046

1306 Environmental Aspects

Refer also to citation(s) 52046

52047 (DOE/BP/37379–T1) **Fifteenmile Basin Habitat Enhancement Project: Annual report FY 1988.** Smith, R.C.; Marx, S.D. Oregon Dept. of Fish and Wildlife, Portland, OR (USA). 1 Apr

1989. 112p. Sponsored by U.S. DOE Management & Administration. DOE Contract AI79-87BP37379. Order Number DE89017701. Available from NTIS, PC A08/MF A01 - OSTI.

The goal of the Fifteenmile Creek Habitat Enhancement Project is to improve wild winter steelhead in the Fifteenmile Creek Basin under the Columbia River Basin Fish and Wildlife Program. The project is funded by through the Bonneville Power Administration. Cooperators in the habitat enhancement project include the USDA Forest Service, Wasco County Soil and Water Conservation District and the Confederated Tribes of the Warms Springs. Installation of instream fish habitat structures was completed on four miles of Ramsey Creek and on one mile of Fifteenmile Creek. One hundred thirty-five structures were installed in treatment areas. Construction materials included logs and rock. Riparian protection fencing was completed on Dry Creek and Ramsey Creek worksites. Five and one-half miles of new fence was added to existing fence on Ramsey Creek to afford riparian protection to four miles of stream. Six miles of stream on Dry Creek will be afforded riparian protection by constructing 4.5 miles of fence to complement existing fence. 2 refs., 5 figs.

52048 (DOE/BP/38372–1) **Development of rations for the enhanced survival of salmon: Annual report 1988.** Ewing, R.D.; Lagasse, J.P. Oregon Dept. of Fish and Wildlife, Portland, OR (USA). Dec 1988. 18p. Sponsored by U.S. DOE Bonneville Power Administration; U.S. DOE Management & Administration. DOE Contract AI79-88BP38372. Order Number DE89017653. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The nutritional quality of feed plays an important role in determining the health and "fitness" of smolts. Commercial fish meal, the major source of protein in salmon rations, may be reduced in quality from poor drying techniques during manufacture. Dietary stress in the hatchery may result. This investigation tests the hypothesis that protein quality of fish rations can influence the survival of smolts and the ultimate return of adults. The test involves a comparison between performances of coho and chinook salmon reared on rations containing very high quality protein derived from vacuum dried meals and those of fish reared on commercial rations, with commercial fish meal as a source of protein. Survival and return of several brood years of test and control fish are used to measure the influence of ration on survival. Rearing and release of tagged fish to date include 1982, 1983, 1984 and 1985 broods of coho salmon; the 1983 and 1984 broods of fall chinook (tule stock) salmon; and the 1985 and 1986 broods of fall chinook (upriver bright stock) salmon. This report includes recovery data from these marked fish collected through September 1988. 2 tabs.

52049 (DOE/BP/91945–1) **Minidoka Dam wildlife impact assessment: Final report, 1989.** Martin, R.C.; Meuleman, G.A. USDOE Bonneville Power Administration, Portland, OR (USA). Div. of Fish and Wildlife; Idaho Dept. of Fish and Game, Boise, ID (USA). Aug 1989. 69p. Sponsored by U.S. DOE Bonneville Power Administration; U.S. DOE Management & Administration. DOE Contract AI79-88BP91945. Order Number DE89017656. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

A wildlife impact assessment has been developed for the US Bureau of Reclamation's Minidoka Dam and Reservoir in south central Idaho. This assessment was conducted to fulfill requirements of the Fish and Wildlife Program. Specific objectives of this study included the following: select target wildlife species, and identify their current status and management goals; estimate the net effects on target wildlife species resulting from hydroelectric development and operation; recommend protection, mitigation, and enhancement goals for target wildlife species affected by hydroelectric development and operation; and consult and coordinate impact assessment activities with the Northwest Power Planning Council, Bonneville Power Administration, US Bureau of Reclamation, Bureau of Land Management, Shoshone-Bannock Tribes, US Fish and Wildlife Service, Pacific Northwest Utilities Conference Committee, and other entities expressing interest in the project. 62 refs., 2 figs., 11 tabs.

14 SOLAR ENERGY

Refer also to citation(s) 52616

52050 (NEDOJ–8809, pp. 93-104) **Outline of solar technology development.** Sugimoto, Takeshi (New Energy Development and Industrial Technology Organization, Tokyo (Japan)). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the 8th NEDO General Assembly.* Available from NTIS (US Sales Only), PC A23/MF A01.

A report is made on the development of solar technology carried out in 1987. The projects in the technical development for practical application of photovoltaic power generation system are; verification of experimental purification of low cost silicon, verification of experimental fabrication of solar panel, study on the practical application of high efficient crystal solar cell and amorphous solar cell, research and development of cell evaluation system, research and development of peripheral technologies, research and development of applied systems of photovoltaic power generation, research and development of concentration type photovoltaic power generation, research and development of photothermic hybrid solar power generation system, and development of manufacturing equipment for compound semiconductor for solar cells. As to the technological development of practical applications for solar systems in the industrial use, research and development were carried out for fixed heat process system, advanced head process system, and long term heat storage system. As regards international technological cooperation relating to solar technology, cooperation between Japan and France, US-Japan, and among many countries, and promotive activities for research cooperation are described.

1401 Resources and Availability

52051 (IEIE–8802, pp. 4) **Distribution of solar spectral irradiance in outer space and on the earth.** Suzuki Mamoru (Kisarazu National College of Technology, Chiba (Japan)). Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related to electricity and information.* Available from NTIS (US Sales Only), PC A02/MF A01.

The irradiance in outer space at the average distance between the sun and the earth is regarded constant and called the Solar Constant. The spectral irradiance can also be deemed constant if the periodical changes in the distance between the sun and the earth are adjusted. The damped amount on the earth of the direct solar radiation after passing through the atmosphere can be comparatively easily calculated. Many calculations have been made to learn the spectral irradiance on the earth by the direct solar radiation based on that in outer space. It has been set as the standard light source for the correction of the efficiency of the standard solar cell. The efficiency of the solar cell depends on the spectral distribution of the irradiation light source, and the same solar cell has different efficiency values, depending on its use in outer space or on the earth. In the case of use in space, correction can be made by the actual measurement using baloons and other devices. Use of the original correction method developed in Japan will enable the measurement of spectral irradiance by the wavelength range which can be sensed by the solar cell. 24 references, 2 figures, 1 table.

52052 (IEIE–8802, pp. 4) **Change of solar radiation energy and factors.** Sekine, Masashi (Nigata Univ. (Japan)). Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related to electricity and information.* Available from NTIS (US Sales Only), PC A02/MF A01.

One of the problems in the use of solar radiation energy is the hourly energy changes caused by many factors. Study on the aspect of the changes of solar radiation energy caused by such meteorological physical factors as aerosol and others which are the main cause for the change in atmospheric transmittance is made. As a result, it became clear that the direct sunlight has a complementary relation with the total skylight. The volume of ozone changes with the season, latitude, and meterological conditions of the troposphere. A brief description is made on the diffusion caused by air. The concentration of the aerosol becomes low with altitude, but it is

believed that the distribution feature in diameter does not change. Atmospheric transmittance is used as the criterion for the expression of the degree of air turbidity caused by differences in aerosol concentration. Recently, methods of distribution and illumination of light to desired indoor and outdoor locations by the introduction of direct sunlight through optical duct and fiber are being aggressively studied and developed. 14 references, 10 figures, 1 table.

52053 **An investigation of the instrumental effects on the historical sunshine record of the United States.** Hameed, S. (Institute for Atmospheric Sciences, Department of Mechanical Engineering, State University of New York, Stony Brook, New York (US)); Pittalwala, I. *Journal of Climate (USA)*, 2(1): 101-104 (Jan 1989).

A statistical analysis indicates that the 1953 change from thermometric recorders to photoelectric switches caused a difference in the registered sunshine that is small compared to natural fluctuations in the data. (AIP)

1403 Economics

Refer also to citation(s) 52042

52054 (ETSU-S–1128A) **Marketability of passive solar house designs. Phase 1. Market research report.** Department of Energy, London (UK). Energy Efficiency Office. 1988. 185p. Available from British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

The results of a number of market research studies on reactions to passive solar features in domestic housing are reported. Interviews were conducted with individuals in the building industry and also potential house-buyers. The detailed conclusions are presented and implications are drawn from these for the research program into passive solar features. (UK).

1405 Solar Energy Conversion

Refer also to citation(s) 52036, 52042, 52044, 52051, 52106, 52508, 52509, 53289, 53293

52055 (DOE/CE/15270–T11) **Explorations of mechanisms regulating ectomycorrhizal colonization of boron-fertilized pine: Quarterly report, July 1, 1989–September 30, 1989.** Garrett, H.E.; Begonia, G.; Sword, M.A. Missouri Univ., Columbia, MO (USA). School of Forestry, Fisheries and Wildlife. 1989. 13p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG01-86CE15270. Order Number DE90001155. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The present study examined the effects of foliar boron fertilization and inoculation with an ectomycorrhizal fungus (Pisolithus tinctorius) on ^{14}C-photosynthate partitioning to various tissues of shortleaf pine seedlings, placing special emphasis on the ^{14}C distribution to the root systems. Specifically, the hypotheses tested are: (a) ^{14}C allocation to the root systems will increase with inoculation, and (b) ^{14}C partitioning will be enhanced by foliar boron application. 13 refs., 3 tabs.

52056 (DOE/ER/13476–1) **[Electron transfer mechanisms in reaction centers]: Final progress report.** Dutton, P.L. Pennsylvania Univ., Philadelphia, PA (USA). Dept. of Biochemistry and Biophysics. [1989]. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-86ER13476. Order Number DE90001204. Available from NTIS, PC A03/MF A01 - OSTI.

The long term goal is to advance our understanding of the mechanisms involved in long-range electron transfer reactions, including charge-separation and stabilization in proteins. We choose to study the photosynthetic bacterial reaction center protein from *Rhodopseudomonas viridis*, { Chromatium} *vinosum* and *Rhodobacter sphaeroides* because they offer several unique experimental opportunities and because the attention recently focused on these proteins has brought us to the brink of understanding why evolution has selected the free energy changes and forward and reverse values for the rates of various electron transfer steps which together define a system of remarkably high quantum and energetic efficiency. The present proposal is focused mainly on the role of nuclear motions of reacting cofactors and/or protein matrix in governing reaction rate and the relationships of the rate to the driving force. The possibility of detecting and measuring the effects of intervening virtual states in a superexchange electron transfer mechanism will be addressed in particular with regard to the primary charge separation key reactions that involve chlorophylls, pheophytins, quinones and hemes associated with the reaction center. The reactions occur in the pico- to the millisecond range. The novel point of the work is that of the measurements will be done on reaction centers in which the free-energy of some of the reactions are altered by as much as 1 eV by combined application of electric fields across monolayer films of reaction centers and the chemical replacement of quinone.

52057 (FRNC-TH–3483) **Cellulases of Trichoderma Reesei. Production and application.** Cochet, N. Universite de Technologie de Compiegne, 60 (France). 1987. 322p. (In French). Order Number DE90713660. Available from NTIS (US Sales Only), PC A14/MF A01.

The main objectives of this study are: hydrolysis of the cellulose produced by agricultural raw materials and production of cellulases with acceptable technical and economical levels; study of a fermentation process conducting to the production of 2.3 Butanediol from the hydrolyzate produced previously; study of the ethanol fermentation of the hexoses contained in the same substrate. An original semi-solid culture fermentation mode is proposed.

52058 (IEIE–8802 vp) **Langmuir project method and physical properties of film.** Iwamoto, Mitsumasa (Tokyo Institute of Technology (Japan)). Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Joint convention record of imstitutes of electorical and imformation engineers, Japan.* Available from NTIS (US Sales Only), PC A02/MF A01.

Reports are made on the physical properties of organic ultrathin film, paricularly the polarization and conductive characteristics of LB film and the application of the elements. L film was evaluated by an electrode measuring method, arranging parallel flat plate electrode on the surface of water in parallel, and the dipole moment was measured. L film has a polarity on the water surface. LB film, when transferred to the substrate, is already polarized at right angles to the surface of the substrate in the state where no electrical field applied from outside. Comparing with thick organic materials which do not polarize unless outside electrical field is applied, the film has a big difference. Cumulated states on a slide during the LB film formation process were recorded, and the change in the amount of electric charge with the rise and fall of the temperature of the sample was measured for comparison. A Josephson junction device was experimentally made by sandwiching LB film with superconducting materials, and 10GHz microwave was irradiated to analyze the characteristics. 11 references, 6 figures, 1 table.

52059 (IEIE–8802, pp. 4) **Vacuum deposition method and physical properties of film. Monolayer.** Yase, Kiyoshi (Hiroshima Univ., Fukuyama (Japan)); Okada, Masakazu. Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related to electricity and information.* Available from NTIS (US Sales Only), PC A02/MF A01.

The structure in film is described with priority given to the method of thin film formation, the molecular orientation of the film having been controlled by vacuum evaporation. In the case with fatty acid and its metallic acid, the temperature of the substrate is correlated with the evaporation rate, and it was found that a desired film can be formed when either of them is properly controlled. The conditions for the deposition are shown. The substrate is heated at 100-200^{0}C before the deposition of organic molecules, and cooled down to a predetermined temperature. Following the deposition of specimen, Ge and carbon are deposited under vacuum with approximately 3nm film thickness. The formed 3 layered film of organic sustance-Ge-Carbon is removed from the surface of the water. Conditions for the formation of entire film with LGH or NGH hillocks only are summarized. Reports are made on the results of formation of LGH dominant thin film, and direct observation by a high resolution electron microscope performed to clarify the crystal structure of the long chain molecule. 5 references, 6 figures, 1 table.

52060 (IEIE–8802, pp. 4) **Vacuum deposition method and physical properties of film. Polymerized film.** Takahashi Yoshikazu (ULVAC Corp., Kanagawa (Japan)); Iijima, Masayuki. Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related to electricity and information.* Available from NTIS (US Sales Only), PC A02/MF A01.

A report is made on the vapor polymerization method which is a new organic high-polymer thin-film formation method. The most remarkable feature of the vapor polymerization method is that polymerization is initiated by the nature of the functional group of organic melocules when more than 2 kinds of monomers are simultaneously evaporated, requiring no outside energy supply. It is clear that the vapor polymerization method utilizes the reactivity which the functional group of organic molecules possess. The reactivity means that the amine component of the functional group becomes electron doner, and acidic substance electron acceptor, reacting to form charge-migration complex (radical) when the monomer molecules collide each other on the surface of the substrate. The skeletal structure of the molecule can be changed by the vapor polymerization method when functional groups are appropriately combined. It became clear that the dielectric constant can be controlled by the selection of combination mode and molecular chains. 9 references, 2 figures, 2 tables.

52061 (IEIE–8802, pp. 4) **Plasma polymerization method and physical properties of film.** Morita, Shinzo (Nagoya Univ. (Japan)). Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related to electricity and information.* Available from NTIS (US Sales Only), PC A02/MF A01.

Reports are made on the plasma polymerization method and physical properties of the produced film together with the result of experiment recently carried out. The reaction in plasma ploymerization can be divided into 3 processes, i.e., excitation of monomer, transfer of active particles from vapor phase to solid surface, and polymerizing reaction on the surface of solid. The film formed by plasma polymerization generally contains residual radical in large quantities. This radical is stable in the bridged molecular chain, and shows little change when subjected to approximately 100^{0}C heat treatment, but reacts with oxygen to produce oxide in the atmosphere. By the excitation particles made by plasma, vinyl macromolecules form a polymerized film which possesses the function of monomer. Synthesis of semiconductive or conductive polymerized films have been tried. Organic thin film has, however, little conductivity as compared with inorganic material film, and is still far from practical application. The plasma process, as a producing method for new materials, enables formation of a variety of films by hybrid materials and processes. 9 references, 3 figures.

52062 (IEIE–8802, pp. 4) **Reaction of polymerized LB film to radiation exposure.** Ogawa, Kazufumi (Matsushita Electric Industrial Co., Ltd., Osaka (Japan)). Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Joint convention record of Institute of Electrical and Information Engineers, Japan.* Available from NTIS (US Sales Only), PC A02/MF A01.

The chemical reaction of LB films having different cumulative conditions are investigated by FTIR spectroscopy and UV spectroscopy to study the relationship between the molecular orientation and reactivity.

52063 (IEIE–8802, pp. 4) **Electrolytic polymerization and physical properties of film.** Yoshino, Katsumi (Osaka, Univ. (Japan)). Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Joint convention record of imstitutes of electrical and imformation engineers, Japan.* Available from NTIS (US Sales Only), PC A02/MF A01.

Synthesis by the electrolytic polymerization of conductive macromolecules and the physical properties of the formed film are described. The most important factors for the electroylytic polymerization method are the kind of solution, supporting electrolyte, and the kind and concentration of the monomer. Explanation is made on polypyrole, polythiophene, polyfuran, etc. as actual examples of electrolytic polymerization of conductive macromolecules. The conductivity and electrical properties of the obtained films are greatly different depending on the methods of polymerization. The film immeidately after the polymerization is in the doping state with high conductivity, and can be considered to be metallic, but loses conductivity by a great extent with the progress of de-doping, and becomes semiconductive or non-conductive. With the progress of doping, plasma reflection is observed in highly doped areas, and the metallic feature becomes evident. This phenomenon may be used as photo- or color-switching elements. It was found that the absorption spectrum of the film undergoes a considerable change with temperature. The magnetic properties also show substantial change depending on the molecular structure and doping. 1 reference, 8 figures.

52064 (N–89-23528, pp. 109-121) **Some examples of the degradation of properties of materials in space.** Betz, F.E.; Hauser, J.A. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. May 1989. (NASA-CP–3035-PT-1;L–16575-PT-1;NAS–1.55:3035-PT-1;CONF-8806434–: NASA/SDIO space environmental effects on materials workshop, Hampton, VA (USA), 28 Jun - 1 jul 1988). In *NASA/SDIO Space Environmental Effects on Materials Workshop, part 1.* Available from NTIS, PC A16/MF A01.

The space environment effects on the silver teflon covering (solar panels) of two SOLRAD SATELLITES AND NTS-Z are examined to analyze the design requirements for the Shuttle Launch Dispenser (SLD).

52065 (N–89-24704) **Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.** National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. 362p. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). Available from NTIS, PC A16/MF A01.

The 9th Space photovoltaic research and technology conference was held at the NASA Lewis Research Center from April 19 to 21, 1988. The papers and workshop summaries report remarkable progress on a wide variety of approaches in space photovoltaics, for both near and far term applications. Among the former is the recently developed high efficiency GaAs/Ge cell, which formed the focus of a workshop discussion on heteroepitaxial cells. Still aimed at the long term, but with a significant payoff in a new mission capability, are InP cells, with their potentially dramatic improvement in radiation resistance. Approaches to near term, array specific powers exceeding 130 W/kg are also reported, and advanced concentrator panel technology with the potential to achieve over 250 W/sq m is beginning to take shape.

52066 (N–89-24704, pp. 19-27) **Progress in indium phosphide solar cell research.** Weinberg, I.; Swartz, C.K.; Hart, R.E. Jr. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

Progress, dating from the start of the Lewis program, is reviewed emphasizing processing techniques which have achieved the highest efficiencies in a given year. To date, the most significant achievement has been attainment of AM0 total area efficiencies approaching 19 percent. Although closed tube diffusion is not considered to be an optimum process, reasonably efficient 2cm x 2cm and 1cm x 2cm InP cells have been produced in quantity by this method with a satellite to be launched in 1990 using these cells.

Proton irradiation of these relatively large area cells indicates radiation resistance comparable to that previously reported for smaller InP cells. A similar result is found for the initial proton irradiations of ITO/InP cells processed by D. C. sputtering. With respect to computer modelling, a comparison of n/p homojunction InP and GaAs cells of identical geometries and dopant concentrations has confirmed the superior radiation resistance of InP cells under 1 MeV electron irradiations.

52067 (N–89-24704, pp. 28-40) **InP shallow-homojunction solar cells.** Keavney, C. (Georgia Inst. of Tech., Atlanta (USA)); Spitzer, M.B.; Vernon, S.M.; Haven, V.E.; Augustine, G. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

Indium phosphide solar cells with very thin n-type emitters have been made by both ion implantation and metalorganic chemical vapor deposition. Air mass zero efficiencies as high as 18.8 percent (NASA measurement) have been achieved. Although calculations show that, as is the case with GaAs, a heterostructure is expected to be required for the highest efficiencies attainable, the material properties of InP give the shallow-homojunction structure a greater potential than in the case of GaAs. The best cells, which were those made by ion implantation, show open-circuit voltage (V sub oc) of 873 mV, short-circuit current of 357 A/sq m (35.7 mA/sq cm), and fill factor of 0.829. Improvements are anticipated in all three of these parameters. Internal quantum efficiency peaks at over 90 percent in the red end of the spectrum, but drops to 54 percent in the blue end. Other cells have achieved 74 percent in the blue end. Detailed modeling of the data indicates that a high front surface recombination velocity is responsible for the low blue response, that the carrier lifetime is high enough to allow good carrier collection from both the base and the emitter, and that the voltage is base-limited.

52068 (N–89-24704, pp. 41-57) **An empirical study of the performance of APMOVPE AM0 InP homojunction solar cells as a function of emitter thickness and doping, and base doping.** Wanlass, M.W.; Gessert, T.A.; Emery, K.A.; Coutts, T.J. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

Their excellent radiation resistance and conversion efficiencies greater than 20 percent, measured under global conditions, make InP shallow-homojunction solar cells very attractive for space or terrestrial application. In addition, modeling studies show that, for optimized design, efficiencies of these devices should exceed 20 percent even under AM0 conditions. However, a systematic experimental investigation of the influence of the various cell design parameters on cell performance has not as yet been made. For the n+/p/p+ structures investigated in the previous modeling study, the design parameters include the impurity concentrations and thicknesses of the emitter and base layers. In the work reported here, researchers discuss an experimental investigation of the effects on cell performance of varying the impurity concentrations of the emitter and base and thickness of the emitter.

52069 (N–89-24704, pp. 58-65) **N/P InP homojunction solar cells with an In0.53Ga0.47As contacting layer grown by liquid phase epitaxy.** Shen, C.C.; Choi, K.Y. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

N/P InP homojunction solar cells with an In sub 0.53 Ga sub 0.47 As contacting layer were fabricated by liquid phase epitaxy (LPE). Electron-Beam-Induced-Current (EBIC) measurements were performed on several selected samples. It was found that the background doping level in the base region sometimes results in a deep junction, which greatly affects the cell performance.

52070 (N–89-24704, pp. 66-78) **Predicted performance of InP solar cells in Cassegrainian and slats space concentrator arrays at 20 to 100 AM0, 80 to 100 C.** Goradia, C. (Cleveland State Univ., OH (USA)); Thesling, W.; Goradia, M.G.; Weinberg, I.; Swartz, C.K. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

Researchers have calculated the expected performance dependence of near-optimally designed shallow homojunction n+pp+InP solar cells on incident intensities up 200 AM0 and temperatures up to 100 C (373K). Both circular and rectangular cells have been considered, the former for use in a Cassegrainian concentrator array at 100 AM0, 80 to 100 C and the latter for use in a Slats type concentrator array at 20 AM0 80 to 100 C. Calculation of the temperature dependence of the performance parameters I sub sc, V sub oc, FF and eta was done by first verifying that the use of the measured temperature variation of I sub sc, of the best published value of the temperature dependence of the bandgap of InP, and of the temperature dependences of the lifetimes and mobilities of electrons and holes the same as in equivalently doped GaAs, gave calculated results that closely matched measured data on the temperature variation of I sub sc, V sub oc, and FF of four existing InP cells at 1 AM0. It was then assumed that the same temperature dependences of I sub sc, the bandgap and lifetimes and mobilities would hold in the near-optimally designed cells at the higher concentrations.

52071 (N–89-24704, pp. 79-89) **Modelling and design of high performance indium phosphide solar cells.** Rhoads, S.L. (Delaware Univ., Newark (USA)); Barnett, A.M. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

A first principles pn junction device model has predicted new designs for high voltage, high efficiency InP solar cells. Measured InP material properties were applied and device parameters (thicknesses and doping) were adjusted to obtain optimal performance designs. Results indicate that p/n InP designs will provide higher voltages and higher energy conversion efficiencies than n/p structures. Improvements to n/p structures for increased efficiency are predicted. These new designs exploit the high absorption capabilities, relatively long diffusion lengths, and modest surface recombination velocities characteristic of InP. Predictions of performance indicate achievable open-circuit voltage values as high as 943 mV for InP and a practical maximum AM0 efficiency of 22.5 percent at 1 sun and 27 C. The details of the model, the optimal InP structure and the effect of individual parameter variations on device performance are presented.

52072 (N–89-24704, pp. 90-98) **Deep levels and radiation effects in p-InP.** Anderson, W.A.; Singh, A.; Jiao, K.; Lee, B. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

A survey was conducted on past studies of hole traps in InP. An experiment was designed to evaluate hole traps in Zn-doped InP after fabrication, after electron irradiation and after annealing using deep level transient spectroscopy. Data similar to that of Yamaguchi was seen with observation of both radiation-induced hole and electron traps at E sub A=0.45 eV and 0.03 eV, respectively. Both traps are altered by annealing. It is also shown that trap parameters for surface-barrier devices are influenced by many factors such as bias voltage, which probes traps at different depths below the surface. These devices require great care in data evaluation.

52073 (N–89-24704, pp. 99-107) **Encapsulated diffusion of sulphur into InP.** Parat, K.K.; Borrego, J.M.; Ghandhi, S.K. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

This talk outlines a simple process for the fabrication of n(+)-p solar cells in indium phosphide. Large area cells (greater than 0.25 sq cm) have been made by this process, with a photovoltaic conversion efficiency of 15.21 percent under AM0 conditions of illumination. An ideality factor of 1.1 and a saturation current density of 8 x 10 to the minus 15th power A/sq cm have been observed for these cells. The technique for cell fabrication involves the diffusion of sulfur into InP by an open tube process, and gives highly reproducible results from run to run. A vacuum-deposited layer of gallium sulphide (Ga2S3) was used as the source for sulfur diffusion, with a chemically vapor deposited SiO2 cap layer to prevent decomposition of the InP surface during heat treatment. Diffusions were carried out in a flowing nitrogen ambient at 585 to 708 C, and characterized by their surface carrier concentration and the diffusion constant. The diffusion profile for sulfur in InP is estimated to be of the complementary error function type. The activation energy of the diffusion was estimated to be 1.94 eV. The technique described here is ideally suited for the fabrication of shallow n(+)-p junctions in InP, and has been used for space-borne solar cells.

52074 (N–89-24704, pp. 111-121) **The impact of solar cell technology on planar solar array performance.** Mills, M.W.; Kurland, R.M. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

The results of a study into the potential impact of advanced solar cell technologies on the characteristics (weight, cost, area) of typical planar solar arrays designed for low, medium and geosynchronous altitude earth orbits are discussed. The study considered planar solar array substrate designs of lightweight, rigid-panel graphite epoxy and ultra-lightweight Kapton. The study proposed to answer the following questions: Do improved cell characteristics translate into array-level weight, size and cost improvements; What is the relative importance of cell efficiency, weight and cost with respect to array-level performance; How does mission orbital environment affect array-level performance. Comparisons were made at the array level including all mechanisms, hinges, booms, and harnesses. Array designs were sized to provide 5kW of array power (not spacecraft bus power, which is system dependent but can be scaled from given values). The study used important grass roots issues such as use of the GaAs radiation damage coefficients as determined by Anspaugh. Detailed costing was prepared, including cell and cover costs, and manufacturing attrition rates for the various cell types.

52075 (N–89-24704, pp. 122-137) **Advanced photovoltaic solar array development.** Kurland, R.M. (TRW Space Technology Labs., Redondo Beach, CA (USA)); Stella, P. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

Phase 2 of the Advanced Photovoltaic Solar Array (APSA) program, started in mid-1987, is currently in progress to fabricate prototype wing hardware that will lead to wing integration and testing in 1989. The design configuration and key details are reviewed. A status of prototype hardware fabricated to date is provided. Results from key component-level tests are discussed. Revised estimates of array-level performance as a function of solar cell device technology for geosynchronous missions are given.

52076 (N–89-24704, pp. 138-145) **Development of tandem cells consisting of GaAs single crystal and CuInSe2/CdZnS polycrystalline thin films.** Kim, N.P. (Kopin Corp., Taunton, MA (USA)); Stanbery, B.J.; Gale, R.P.; Mcclelland, R.W. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

The tandem cells consisting of GaAs single crystal and CuInSe2 polycrystalline thin films are being developed under the joint program of the Boeing Co. and Kopin Corp. to meet the increasing power needs for future spacecraft. The updated status of this program is presented along with experimental results such as cell performance, and radiation resistance. Other cell characteristics including the specific power of and the interconnect options for this tandem cell approach are also discussed.

52077 (N–89-24704, pp. 146-150) **Directions for further development of GaAs/CuInSe2 thin film tandem cells.** Stanbery, B.J. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

Multijunction thin film solar cells utilizing GaAs and CuInSe2 as semiconductor absorbers are rapidly developing, becoming a viable technology for space power systems with an unparalleled combination of high efficiency, low mass, and high radiation tolerance. The prospect for evolutionary improvement of this type of cell towards efficiency of approximately equals 30 percent and specific power greater than 1 kW/kg while retaining the attribute of high radiation tolerance are good. Limitations of the present configuration and possible avenues for circumventing these problems are presented.

52078 (N–89-24704, pp. 151-161) **Ultra-thin, light-trapping silicon solar cells.** Landis, G.A. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

Design concepts for ultra-thin (2 to 10 microns) high efficiency single-crystal silicon cells are discussed. Light trapping allows more light to be absorbed at a given thickness, or allows thinner cells of a given Jsc. Extremely thin cells require low surface recombination velocity at both surfaces, including the ohmic contacts. Reduction of surface recombination by growth of heterojunctions of ZnS and GaP on Si has been demonstrated. The effects of these improvements on AM0 efficiency is shown. The peak efficiency increases, and the optimum thickness decreases. Cells under 10 microns thickness can retain almost optimum power. The increase of absorptance due to light trapping is considered. This is not a problem if the light-trapping cells are sufficiently thin. Ultra-thin cells have high radiation

tolerance. A 2 microns thick light-trapping cell remains over 18 percent efficient after the equivalent of 20 years in geosynchronous orbit. Including a 50 microns thick coverglass, the thin cells had specific power after irradiation over ten times higher than the baseline design.

52079 (N–89-24704, pp. 162-163) **Deployable aerospace PV array based on amorphous silicon alloys.** Hanak, J.J.; Walter, L.; Dobias, D.; Flaisher, H. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

The development of the first commercial, ultralight, flexible, deployable, PV array for aerospace applications is discussed. It is based on thin-film, amorphous silicon alloy, multijunction, solar cells deposited on a thin metal or polymer by a proprietary, roll-to-roll process. The array generates over 200 W at AM0 and is made of 20 giant cells, each 54 cm x 29 cm (1566 sq cm in area). Each cell is protected with bypass diodes. Fully encapsulated array blanket and the deployment mechanism weigh about 800 and 500 g, respectively. These data yield power per area ratio of over 60 W/sq m specific power of over 250 W/kg (4 kg/kW) for the blanket and 154 W/kg (6.5 kg/kW) for the power system. When stowed, the array is rolled up to a diameter of 7 cm and a length of 1.11 m. It is deployed quickly to its full area of 2.92 m x 1.11 m, for instant power. Potential applications include power for lightweight space vehicles, high altitude balloons, remotely piloted and tethered vehicles. These developments signal the dawning of a new age of lightweight, deployable, low-cost space arrays in the range from tens to tens of thousands of watts for near-term applications and the feasibility of multi-100 kW to MW arrays for future needs.

52080 (N–89-24704, pp. 167-176) **High efficiency GaAs-Ge tandem solar cells grown by MOCVD.** Vernon, S.M. (Spectrolab, Inc., Sylmar, CA (USA)); Tobin, S.P.; Bajgar, C.; Haven, V.E.; Geoffroy, L.M.; Lillington, D.R.; Hart, R.E. Jr. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

High conversion efficiency and low weight are obviously desirable for solar cells intended for space applications. One promising structure is GaAs on Ge. The advantages of using Ge wafers as substrates include the following: they offer high efficiency by forming a two-junction tandem cell; low weight combined with superior strength allows usage of thin (3 mil) wafers; and they are a good substrate for GaAs, being lattice matched, thermal expansion matched, and available as large-area wafers.

52081 (N–89-24704, pp. 177-189) **Response of single junction GaAs/GaAs and GaAs/Ge solar cells to multiple doses of 1 MeV electrons.** Meier, D.L. (Air Force Wright-Patterson Aeronautical Labs., Wright-Patterson AFB, OH (USA)); Szedon, J.R.; Bartko, J.; Chung, M.A. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

A comparison of the radiation tolerance of MOCVD-grown GaAs cells and GaAs/Ge cells was undertaken using 1 MeV electrons. The GaAs/Ge cells are somewhat more tolerant of 1 MeV electron irradiation and more responsive to annealing than are the GaAs/GaAs cells examined in this study. However, both types of cells suffer a greater degradation in efficiency than has been observed in other recent studies. The reason for this is not certain, but it may be associated with an emitter thickness which appears to be greater than desired. The deep level transient spectroscopy (DLTS) spectra following irradiation are not significantly different for the GaAs/Ge and the GaAs/GaAs cells, with each having just two peaks. The annealing behavior of these peaks is also similar in the two samples examined. It appears that no penalty in radiation tolerance, and perhaps some benefit, is associated with fabricating MOCVD GaAs cells on Ge substrates rather than GaAs substrates.

52082 (N–89-24704, pp. 190-200) **A three solar cell system based on a self-supporting, transparent AlGaAs top solar cell.** Negley, G.H. (Delaware Univ., Newark (USA)); Rhoads, S.L.; Terranova, N.E.; Mcneely, J.B.; Barnett, A.M. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

Development of a three solar cell stack can lead to practical efficiencies greater than 30 percent (1x,AM0). A theoretical efficiency limitation of 43.7 percent at AM0 and one sun is predicted by this model. Including expected losses, a practical system efficiency of 36.8 percent is anticipated. These calculations are based on a 1.93eV/1.43eV/0.89eV energy band gap combination. AlGaAs/GaAs/GaInAsP materials can be used with a six-terminal wiring configuration. The key issues for multijunction solar cells are the top and middle solar cell performance and the sub-bandgap transparency. AstroPower has developed a technique to fabricate AlGaAs solar cells on rugged, self-supporting, transparent AlGaAs substrates. Top solar cell efficiencies greater than 11 percent AM0 have been achieved. State-of-the-art GaAs or InP devices will be used for the middle solar cell. GaInAsP will be used to fabricate the bottom solar cell. This material is lattice-matched to InP and offers a wide range of bandgaps for optimization of the three solar cell stack. Liquid phase epitaxy is being used to grow the quaternary material. Initial solar cells have shown open-circuit voltages of 462 mV for a bandgap of 0.92eV. Design rules for the multijunction three solar cell stack are discussed. The progress in the development of the self-supporting AlGaAs top solar cell and the GaInAsP bottom solar cell is presented.

52083 (N–89-24704, pp. 203-220) **Investigation of high efficiency GaAs solar cells.** Olsen, L.C. (Spire Corp., Bedford, MA (USA)); Dunham, G.; Addis, F.W.; Huber, D.; Linden, K. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

Investigations of basic mechanisms which limit the performance of high efficiency GaAs solar cells are discussed. P/N heteroface structures have been fabricated from MOCVD epiwafers. Typical AM1 efficiencies are in the 21 to 22 percent range, with a SERI measurement for one cell being 21.5 percent. The cells are nominally 1.5 x 1.5 cm in size. Studies have involved photoresponse, T-I-V analyses, and interpretation of data in terms of appropriate models to determine key cell parameters. Results of these studies are utilized to determine future approaches for increasing GaAs solar cell efficiencies.

52084 (N–89-24704, pp. 221-228) **A new structure for comparing surface passivation materials of GaAs solar cells.** Desalvo, G.C.; Barnett, A.M. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

The surface recombination velocity (S sub rec) for bare GaAs is typically as high as 10 to the 6th power to 10 to the 7th power cm/

sec, which dramatically lowers the efficiency of GaAs solar cells. Early attempts to circumvent this problem by making an ultra thin junction (xj less than .1 micron) proved unsuccessful when compared to lowering S sub rec by surface passivation. Present day GaAs solar cells use an GaAlAs window layer to passivate the top surface. The advantages of GaAlAs in surface passivation are its high bandgap energy and lattice matching to GaAs. Although GaAlAs is successful in reducing the surface recombination velocity, it has other inherent problems of chemical instability (Al readily oxidizes) and ohmic contact formation. The search for new, more stable window layer materials requires a means to compare their surface passivation ability. Therefore, a device structure is needed to easily test the performance of different passivating candidates. Such a test device is described.

52085 (N–89-24704, pp. 229-237) **Improved defect analysis of gallium arsenide solar cells using image enhancement.** Kilmer, L.C.; Honsberg, C.; Barnett, A.M.; Phillips, J.E. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

A new technique has been developed to capture, digitize, and enhance the image of light emission from a forward biased direct bandgap solar cell. Since the forward biased light emission from a direct bandgap solar cell has been shown to display both qualitative and quantitative information about the solar cell's performance and its defects, signal processing techniques can be applied to the light emission images to identify and analyze shunt diodes. Shunt diodes are of particular importance because they have been found to be the type of defect which is likely to cause failure in a GaAs solar cell. The presence of a shunt diode can be detected from the light emission by using a photodetector to measure the quantity of light emitted at various current densities. However, to analyze how the shunt diodes affect the quality of the solar cell the pattern of the light emission must be studied. With the use of image enhancement routines, the light emission can be studied at low light emission levels where shunt diode effects are dominant.

52086 (N–89-24704, pp. 238-249) **Aging behavior of Au-based ohmic contacts to GaAs.** Fatemi, N.S. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

Gold based alloys, commonly used as ohmic contacts for solar cells, are known to react readily with GaAs. It is shown that the contact interaction with the underlying GaAs can continue even at room temperature upon aging, altering both the electrical characteristics of the contacts and the nearby pn junction. Au-Ge-Ni as-deposited (no heat-treatment) contacts made to thin emitter (0.15 microns) GaAs diodes have shown severe shunting of the pn junction upon aging for several months at room temperature. The heat-treated contacts, despite showing degradation in contact resistance, did not affect the underlying pn junction. Au-Zn-Au contacts to p-GaAs emitter (0.2 microns) diodes, however, showed slight improvement in contact resistance upon 200 C isothermal annealing for several months, without degrading the pn junction. The effect of aging on electrical characteristics of the as-deposited and heat-treated contacts and the nearby pn junction, as well as on the surface morphology of the contacts are presented.

52087 (N–89-24704, pp. 250-263) **Chemical etching and organometallic chemical vapor deposition on varied geometries of GaAs.** Bailey, S.G.; Landis, G.A.; Wilt, D.M. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

Results of micron-spaced geometries produced by wet chemical etching and subsequent OMCVD growth on various GaAs surfaces are presented. The polar lattice increases the complexity of the process. The slow-etch planes defined by anisotropic etching are not always the same as the growth facets produced during MOCVD deposition, especially for deposition on higher-order planes produced by the hex groove etching.

52088 (N–89-24704, pp. 267-271) **Status of GaAs solar cell production.** Yeh, Milton; Ho, Frank; Iles, P.A. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

Recent experience in producing GaAs solar cells, to meet the full requirements of space-array manufacturers is reviewed. The main problems have been in extending MOCVD technology to provide high throughput of high quality epitaxial layers, and to integrate the other important factors needed to meet the full range of user requirements. Some discussion of evolutionary changes is also given.

52089 (N–89-24704, pp. 272-276) **Flexibility in space solar cell production.** Khemthong, S.; Iles, P.A. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

The wide range of cells that must be available from present-day production lines for space solar cells are described. After over thirty years of space-cell use, there is very little standardization in solar cell design. It is not generally recognized what a wide range of designs must remain available on cell production lines. This range of designs is surveyed.

52090 (N–89-24704, pp. 277-285) **Gallium arsenide welded panel technology for advanced spaceflight applications.** Lillington, D.R. (Spire Corp., Bedford, MA (USA)); Gillanders, M.S.; Garlick, G.F.J.; Cavicchi, B.T.; Glenn, G.S.; Tobin, S.P. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

A significant impediment to the widespread use of GaAs solar cells in space is the cost and weight of the GaAs substrate. In order to overcome these problems, Spectrolab is pursuing thin cell technologies encompassing both liquid phase epitaxy (LPE) GaAs on GaAs and MOCVD GaAs on Ge cells. Spectrolab's experience in the manufacture of 4 to 6 mil 2 cm x 4 cm GaAs cells on a LPE production line is discussed. By thinning the cells at a late state of processing, production yields comparable to 12 mil cells have been achieved. Data are presented showing that GaAs cells can be welded without degradation and have achieved minimum average efficiencies of 18 percent AM0, 28 C with efficiencies up to 20 percent. Spectrolab, in conjunction with Spire Corporation has also been pursuing GaAs on Ge cell technology in support of larger area lighter weight power systems. Data are presented showing that individual 2 cm x 2 cm, 8 mil cell efficiencies up to 21.7 percent have been achieved. Efficiencies up to 24 percent AM0 will be possible by optimizing the GaAs/Ge interface. Cells have been welded without degradation using silver interconnects and have been laid down on an aluminum honeycomb/graphite facesheet substrate to produce a small coupon. The efficiency was 18.1 percent at AM0, 28 C.

52091 (N–89-24704, pp. 292-297) **The 25 percent-efficient GaAs Cassegrainian concentrator cell.** Hamaker, H.C.; Grounner, M.; Kaminar, N.R.; Kuryla, M.S.; Ladle, M.J.; Liu, D.D.; MacMillan, H.F.; Partain, L.D.; Virshup, G.F.; Werthen, J.G. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

Very high-efficiency GaAs Cassegrainian solar cells have been fabricated in both the n-p and p-n configurations. The n-p configuration exhibits the highest efficiency at concentration, the best cells having an efficiency eta of 24.5 percent (100X, AM0, temperature T = 28 C). Although the cells are designed for operation at this concentration, peak efficiency is observed near 300 suns (eta = 25.1 percent). To our knowledge, this is the highest reported solar cell efficiency for space applications. The improvement in efficiency over that reported at the previous SPRAT conference is attributed primarily to lower series resistance and improved grid-line plating procedures. Using previously measured temperature coefficients, researchers estimate that the n-p GaAs cells should deliver approximately 22.5 percent efficiency at the operating conditions of 100 suns and T = 80 C. This performance exceeds the NASA program goal of 22 percent for the Cassegrainian cell. One hundred Cassegrainian cells have been sent to NASA as deliverables, sixty-eight in the n-p configuration and thirty-two in the p-n configuration.

52092 (N–89-24704, pp. 301-305) **Contamination effects of GPS Navstar solar array performance.** Marvin, D.C.; Hwang, W.C. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

The solar arrays on Navstars 1 to 6 have been limiting the electrical power capabilities in the extended life (beyond the 5 year design life). The departure from predicted performance consists of an extra 2.5 percent per year degradation beyond the radiation model estimates. This degradation is unusual in showing a linear rather than exponential decay with time. The performance of the arrays on these satellites has been examined in order to predict future behavior and to make refined projections on the Navstar 7 to 11 solar arrays. Evidence obtained from flight experiments on Navstar 5 and 6, and from laboratory experiments, suggests that contamination of the solar arrays while on orbit may be responsible. The evidence for photo-induced contamination of spacecraft surfaces is presented, and the effect on solar array output in the case of the GPS satellites is shown to be consistent with the observed anomalies.

52093 (N–89-24704, pp. 323-331) **AM0 efficiency measurements.** Emery, K.; Osterwald, C. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

Procedures for measuring the air mass zero (AM0) current versus voltage characteristics and calculating the efficiency are discussed. The various factors influencing the determination of the efficiency include the I-V measurement system, reference cell calibration, standard reporting conditions, area measurement, light source characteristics, temperature measurement and control, and the measurement procedures. Each of these sources contributes to the precision index and bias limit which is combined to obtain the total uncertainty in the efficiency. These factors are discussed as well as how to minimize differences in the reported AM0 efficiency of a given PV cell between various laboratories.

52094 (N–89-24704, pp. 332-338) **A comparison of the radiation tolerance characteristics of multijunction solar cells with series and voltage-matched configurations.** Gee, J.M. (Sandia National Labs., Albuquerque, NM (USA)); Curtis, H.B. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

The effect of series and voltage-matched configurations on the performance of multijunction solar cells in a radiation environment was investigated. It was found that the configuration of the multijunction solar cell can have a significant impact on its radiation tolerance characteristics.

52095 (N–89-24704, pp. 339-347) **Radiation resistance studies of amorphous silicon films.** Woodyard, J.R.; Payson, J.S. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

Hydrogenated amorphous silicon thin films were irradiated with 2.00 MeV helium ions using fluences ranging from 1E11 to 1E15 cm(-2). The films were characterized using photothermal deflection spectroscopy and photoconductivity measurements. The investigations show that the radiation introduces sub-band-gap states 1.35 eV below the conduction band and the states increase supralinearly with fluence. Photoconductivity measurements suggest the density of states above the Fermi energy is not changing drastically with fluence.

52096 (NEDO–8809, pp. 129-145) **Development of photovoltaic power generation technology. Development of high-efficient fabrication technology for crystal system solar cell.** Iguchi, Toshio (Sharp Corp., Osaka (Japan)). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the 8th NEDO General Assembly.* Available from NTIS (US Sales Only), PC A23/MF A01.

Commissioned by NEDO, technological developments of solar cells and photovoltaic power generation systems have been carried on since 1980 to study their practicability. The characteristics of the solar cell using polycrystalline substrate have become superior to those of the single-crystal cell. The history of the study on the practical application of polycrystalline solar cell is described. For practical application of solar cells, cost reduction is one of the most important factors, and the cost is indicated by the cost for unit power generation capacity. For the development of high efficient cells, fabrication technology, development of low energy process, development of passivation technology, and study on quality improvement method for substate were carried out. The subjects required are the optimization of low energy process, improvement of passivation effect through detailed study on current collecting efficiency, and the establishment of substrate quality improvement technology by which stable and high conversion efficiency values can be obtained. The solar cell which uses a polycrystalline silicon substrate withstands long term power generation with better characteristics than those of the single crystal. 15 figures.

52097 (NEDO–8809, pp. 146-169) **Development of photovoltaic power generation technology. Development of high efficient production technology for amorphous solar cell.** Kuwano, Yukinori (Sanyo Electric Co., Ltd., Moriguchi (Japan)). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the 8th NEDO General Assembly.* Available from NTIS (US Sales Only), PC A23/MF A01.

Result of the Study on Practical Application of Amorphous Solar Cell, a project commissioned by NEDO, is reported. The investigation in 1987 was carried out from the viewpoints of higher

performance, higher efficiency and better reliability. World's best effective conversion rate of 7.79% was achieved for the solar cell made by the high rate formation, and a world record of 9.6% for the solar cell made at the normal film formation rate. Reports are made on the development of high speed amorphous film formation technology, high efficient modularization technology, high efficient amorphous solar cell, and high reliability technology. From now on, it is required to improve the quality of film formed by high rate processing, establish modularization technology, reduce energy loss inside the solar cell, and elucidate the mechanism of deterioration caused by light. 28 figures, 2 tables.

52098 (ORNL/FTR–3388) **[The physics and chemistry of microalgal photosynthesis]: Foreign trip report, September 1-20, 1989.** Greenbaum, E. Oak Ridge National Lab., TN (USA). 29 Sep 1989. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90001096. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler was invited to present lectures on ORNL research in the physics and chemistry of photosynthesis and microalgal biotechnology at the First International Conference on Marine Biotechnology and the Second International Conference on Molecular Electronics and Biocomputers. In addition, professional colleagues in the Department of Bioengineering, Tokoyo Institute of Technology, and the Department of Molecular Biology and Biological Physics, Moscow State University, invited him to present research seminars at their respective institutes. One afternoon was spent in the Tokyo offices of Mitsubishi Heavy Industries discussing the greenhouse effect, carbon dioxide reduction, possible global warming and the production of nongreenhouse gas fuels.

52099 (SAND–88-7149) **Carbon monoxide rich methanation kinetics on supported rhodium and nickel catalysts.** Keehan, D.; Richardson, J.T. Sandia National Labs., Albuquerque, NM (USA); Houston Univ., TX (USA). Dept. of Chemical Engineering. Aug 1989. 221p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. Order Number DE90000898. Available from NTIS, PC A11/MF A01 - OSTI; GPO Dep.

Utilization of CO_2 reforming of methane in a solar-based chemical energy transmission system depends upon the development of suitable catalysts for the endothermic and exothermic reactions. Reforming of methane produces hydrogen and carbon monoxide at a ratio of about one, thus requiring the methanation reaction on the other side of the closed-loop chemical energy system to use this feed. H_2/CO ratios lower than three favor formation of carbon with industrial methanation catalysts. Preliminary tests of methanation with rhodium and nickel catalysts produced two, 0.5% Rh/Al_2O_3 and 70% Ni/Al_2O_3, for further study. Kinetic experiments were conducted in an isothermal continuous-stirred tank reactor constructed of a copper alloy, which prevented carbon formation on reactor parts. These experiments were performed on pelleted 0.5% Rh/Al_2O_3 in the 400 to 500°C range and pelleted 70% Ni/Al_2O_3 in the 300 to 500°C range. In most experiments, steam was added to the reactor feed to inhibit carbon formation. Langmuir-Hinshelwood expressions were fitted to experimental data for both catalysts and are suitable for reactor design purposes. Lifetime studies, at high CO conversion, were run for both catalysts. The 0.5% Rh/Al_2O_3 resists carbon formation very well and is recommended for application at temperatures above 400°C. The 70% Ni/Al_2O_3 has a high carbon resistance at temperatures below 350°C and is suitable for application from 300 to 350°C. 39 refs., 99 figs.

52100 (SERI/STR–211-3508) **Instability of a-Si:H/Ag interface at 150°C: Annual subcontract report, 1 September 1987–31 August 1988.** Nicolet, M.A.; Tran, L.T. California Inst. of Tech., Pasadena, CA (USA). May 1989. 18p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. Order Number DE89009419. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report documents the results of an investigation of the interaction of silver (Ag) with a-Si:H films in order to evaluate the possible effect of Ag on solar cell degradation. After 5 hours at 250°C, grains of polycrystalline silicon are found in the Ag layer. No difference is detected in the behavior between i-, n-, p-type a-Si:H thin films. The process also occurs in a-Si:H/Al where it is even more pronounced. After annealing at 150°C for 120 hours, some polycrystalline silicon is detected in a-Si:H/Al, but none in the a-Si:H/Ag system. 5 refs., 9 figs., 1 tab.

52101 (SERI/STR–211-3525) **Research on amorphous silicon-germanium alloys for tandem solar cells: Annual subcontract report, 1 September 1987–31 August 1988.** Paul, W. Harvard Univ., Cambridge, MA (USA). Div. of Applied Sciences. Jun 1989. 131p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. Order Number DE89009436. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

This report presents results of research on amorphous silicon-germanium alloys for tandem solar-cell applications. A study was completed of a-$Si_{1-x}Ge_x$:H and a-$Si_{1-x}Ge_x$:H:F alloys. This included extensive structural examination by transmission electron spectroscopy, gas evolution, and differential scanning calorimetry, and also a measurement of the dependence of the mobility-lifetime product for electrons in the two types al alloys. It also included a project to deposit for electron in the two types of alloys. It also included a project to deposit a- Si:H and its alloys by photochemical vapor deposition, which is described. Microstructure, on a scale of 100 angstroms, appears to be an important determinant of film properties. Structure can also be modified by altering the proportions of SiH_4, GeH_4, and H_2 used in growing the films. Films grown by photo-CVD were compared with those grown by conventional glow discharge. 65 refs., 19 figs.

52102 (SERI/STR–211-3526) **Research on high-efficiency, multiple-gap, multijunction, amorphous-silicon-based alloy thin-film solar cells: Semiannual subcontract report, 1 March 1988–31 August 1988.** Guha, S. Solar Energy Research Inst., Golden, CO (USA); Energy Conversion Devices, Inc., Troy, MI (USA). Jun 1989. 63p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. Order Number DE89009444. Available from NTIS, PC A04/MF A01 - OSTI.

This report presents results of research on advancing our understanding of amorphous-silicon-based alloys and their use in small-area multijunction solar cells. The principal objectives of the program are to develop a broad scientific base for the chemical, structural, optical, and electronic properties of amorphous-silicon-based alloys; to determine the optimum properties of these alloy materials as they relate to high-efficiency cells; to determine the optimum device configuration for multijunction cells; and to demonstrate proof-of-concept, multijunction, a-Si-alloy-based solar cells with 18% efficiency under standard AM1.5 global insolation conditions and with an area of at least 1 cm^2. A major focus of the work done during this reporting period was the optimization of a novel, multiple-graded structure that enhances cell efficiency through band-gap profiling. The principles of the operation of devices incorporating such a structure, computer simulations of those, and experimental results for both single- and multijunction cells prepared by using the novel structure are discussed in detail. 14 refs., 35 figs., 7 tabs.

52103 (SERI/STR–211-3527) **Study of microcrystalline, silicon-carbon p-layers prepared by photo-CVD and glow discharge: Final subcontract report, 1 December 1987–30 November 1988.** Schade, H. Chronar Corp., Princeton, NJ (USA). Jun 1989. 16p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. Order Number DE89009438. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Preparation conditions were established for microcrystalline silicon (uc-Si:H) p-type films deposited by both mercury-sensitized photochemical vapor deposition and rf glow discharge. The degree of microcrystallinity in individual films was evaluated in terms of the dark conductivity and optical absorption. Both deposition methods have produced uc-Si: p-layers with conductivities as high as 0.5 S/cm, and optical band gaps between 2.0 and 2.4 eV. For the deposition of such films on glass, a strong decrease of the conductivity below thicknesses of about 100 nm is observed, which is associated with a percolation threshold for conduction. Based on this observation, relatively thick microcrystalline p-layers were incorporated into p-i-n structures. The effect of microcrystallinity is demonstrated by an improvement in the open-circuit voltage, whereas a reduction of the short-circuit current is accounted for by a decrease in the blue-response, due to the excessive absorbance

of the relatively thick microcrystalline p-layer. Efficiency improvements require microcrystalline p-layers of lower absorbance, and/or higher conductivity of thinner layers, provided substantial barrier formation at the conductive-transparent-oxide/p-layer interface can be avoided. 15 refs., 8 figs., 5 tabs.

52104 Site-directed mutagenesis in photosystem II of the cyanobacterium Synechocystis sp. PCC 6803: Donor D is a tryosine residue in the D2 protein. Vermaas, W.F.J. (Arizona State Univ., Tempe (USA)); Rutherford, A.W.; Hansson, O. *Proceedings of the National Academy of Sciences of the United States of America (USA),* 85(22): 8477-8481 (Nov 1988). DOE Contract FG02-88ER13969.

The chemical nature of electron donor(s) in photosystem II in photosynthetic membranes was analyzed by site-directed mutagenesis of the gene encoding the protein D2 of the photosystem II reaction center. Mutation of the Try-160 residue of the D2 protein into phenylalanine results in the disappearance of the electron paramagnetic resonance signal II_s originating from D^+, the oxidized form of the slow photosystem II electron donor D. Signal II_s is still present if a neighboring residue in D2, Met-159, is mutated into arginine. Both mutants have normal rereduction kinetics of the oxidized primary electron donor, $P680^+$, in octyl glucoside-extracted thylakoids, indicating that D is not directly involved in $P680^+$ reduction. However, overall photosystem II activity appears to be impaired in the Try-160-Phe mutant: photosystem II-dependent growth of this mutant is slowed down by a factor of 3-4, whereas photoheterotrophic growth rates in wild type and mutant are essentially identical. Binding studies of diuron, a photosystem II herbicide, show that there is no appreciable decrease in the number of photosystem II centers in the Tyr-160-Phe mutant. The decrease in photosystem II activity in this mutant may be interpreted to indicate a role of D in photoactivation, rather than one as an important redox intermediate in the photosynthetic electron-transport chain.

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Refer also to citation(s) 52065, 52096, 52097

52105 (ETDE-IT–89-08) **Optimal control of photovoltaic systems by a new battery state-of-charge observer.** Giglioli, R.; Zini, G.; Conte, M.; Raugi, M. Pisa Univ. (Italy); ENEA, Casaccia (Italy). Centro Ricerche Energia. Jun 1988. 6p. (CONF-880665–5: 33. international power source symposium, Cherry Hill, NJ (USA), 13-16 Jun 1988). Order Number DE89793124. Available from NTIS (US Sales Only), PC A02/MF A01.

In photovoltaic power plants, the ability to accurately determine battery state-of-charge at any given time can reduce the risk of curtailed energy and allow more precise and less costly battery sizing. In this paper, a new state-of-charge observer, based on an original equivalent electric network of the lead-acid battery, is shown and used to develop an optimal control of the system. Hence, a management plan for a complete photovoltaic system is studied. Finally, a comparison between a simulation of the proposed plan and experimental data from a monitored photovoltaic plant, with very simple management requirements, is made and discussed. The present work was carried out within the framework of the Italian Finalized Energy Project-2.

52106 (IEIE–8802, pp. 4) **Latest trend of photovoltaic-power generation for energy conversion.** Kurokawa, Hirosuke (Electrotechnical Lab., Tsukuba (Japan)). Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related to electricity and information.* Available from NTIS (US Sales Only), PC A02/MF A01.

The history of the production and application tenchnologies for solar cells is described together with the necessary peripheral supporting technologies such as quality control, system design, etc. Following the description on the history of research and development of photovoltaic power generation, current technological levels of the improvement in efficiencies of various solar cells and an example for the future are reported. Recently, solar cells whose conversion efficiences are higher than 30% are being proposed in Japan and other countries. Many experimental systems were established since 1980. Apart from the NEDO's projects, research work started in 1985 to search new seeds for new technologies. Annual production of solar cells increased to about 13,000kW in 1986, and the cost per watt is said to be about 900 Yen at present. Viewed worldwide, crystal type is prevailing for power cells, occupying 2/3 of the total production. The remaining 1/3 are amorphous solar cells which are mainly used for table-top and portable calculators. 2/3 of the total production in Japan in the past few years are amorphous solar cells. 13 references, 2 figures, 1 table.

52107 (JSES–8801, pp. 29-32) **Consideration on data sampling speed for energetic measurement of photovoltaic power generating system.** Kurokawa, Hirosuke (Electrotechnical Lab., Tsukuba (Japan)); Mine, Hisaichi. Japan Solar Energy Society, Tokyo (Japan). 1988. (In Japanese). (CONF-881293–: JSES and JWEA joint conference, Kumamoto (Japan), 1-2 Dec 1988). In *Abstracts of 1988 JSES-JWEA joint conference.* Order Number DE89782163. Available from NTIS (US Sales Only), PC A13/MF A01.

The solar radiation which is the input energy for photovoltaic power generating systems has the basic day-and-night cycle and an irregular time-varying factor caused by meteorological conditions. Data sampling interval of 10 seconds is generally employed which is satisfactory for accurate measurement. In preparation for the future when simpler measurement system may be introduced, sampling intervals must be studied from a different standpoint. For quantitative study on the problem, measurement errors produced by calculation are evaluated using day data which are expressed as actual integrated error curves. The day data expressed as integrated error curves are approximated by 2 parameters, and the parameters were statistically processed. The envelope E, the maximum value of irregular error produced by integration can be shown, using integrated time interval h, by the equation $E=C^*h^{\alpha}$, which indicates the possibility of efficient statistical processing using the equation. 2 refs., 11 figs.

52108 (N–89-23517) **Photovoltaic power system considerations for future lunar bases.** Flood, D.J.; Appelbaum, J. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1989. 8p. (NASA-TM–102019;E–4744;NAS–1.15:102019;CONF-890211–: 4. international photovoltaic science and engineering conference, Sydney (Australia), 14-17 Feb 1989). Available from NTIS, PC A02/MF A01.

The cost of transportation to the lunar surface places a premium on developing ultralightweight power system technology to support the eventual establishment of a lunar base. The photovoltaic technology issues to be addressed by the Surface Power program element of NASA's Project Pathfinder are described.

52109 (N–89-23547, pp. 559-563) **Contamination.** Maag, C.R. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. May 1989. (NASA-CP–3035-PT-2;L–16575-PT-2;NAS–1.55:3035-PT-2;CONF-8806434–: NASA/SDIO space environmental effects on materials workshop, Hampton, VA (USA), 28 Jun - 1 jul 1988). In *NASA/SDIO Space Environmental Effects on Materials Workshop, part 2.* Available from NTIS, PC A12/MF A01.

Contamination of spacecraft in the aerospace environment is examined. The optical systems, thermal control systems and solar power systems were deemed to be most vulnerable to particle damage. It was decided that all orbits should be considered. Specific issues concern whether there are changes in transmittance of optics and the radiative properties of protective coatings.

52110 (N–89-24427) **Energy storage and thermal control system design status.** Simons, S.N.; Willhoite, B.C.; Vanommering, G. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1989. 8p. (NASA-TM–102136;E–4933;NAS–1.15:102136;CONF-890815–: 24. intersociety energy conversion engineering conference, Arlington, VA (USA), 6-11 Aug 1989). Available from NTIS, PC A02/MF A01.

The Space Station Freedom electric power system (EPS) will initially rely on photovoltaics for power generation and Ni/H2 batteries for electrical energy storage. The current design for and the development status of two major subsystems in the PV Power Module is

discussed. The energy storage subsystem comprised of high capacity Ni/H2 batteries and the single-phase thermal control system that rejects the excess heat generated by the batteries and other components associated with power generation and storage is described.

52111 (N–89-24704, pp. 10-15) **Space power technology 21: Photovoltaics.** Wise, J. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

The Space Power needs for the 21st Century and the program in photovoltaics needed to achieve it are discussed. Workshops were conducted in eight different power disciplines involving industry and other government agencies. The Photovoltaics Workshop was conducted at Aerospace Corporation in June 1987. The major findings and recommended program from this workshop are discussed. The major finding is that a survivable solar power capability is needed in photovoltaics for critical Department of Defense missions including Air Force and Strategic Defense Initiative. The tasks needed to realize this capability are described in technical, not financial, terms. The second finding is the need for lightweight, moderately survivable planar solar arrays. High efficiency thin III-V solar cells can meet some of these requirements. Higher efficiency, longer life solar cells are needed for application to both future planar and concentrator arrays with usable life up to 10 years. Increasing threats are also anticipated and means for avoiding prolonged exposure, retraction, maneuvering and autonomous operation are discussed.

52112 (NEDOJ–8809, pp. 105-128) **Development of photovoltaic-power generation technology. Research and development for control technology verification of connection to electric power system.** Yamaguchi, Takuyo (Kansai Electric Power Co., Inc., Osaka (Japan)). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the 8th NEDO General Assembly.* Available from NTIS (US Sales Only), PC A23/MF A01.

Commissioned by NEDO to carry out the Research and Development of Peripheral Technologies, verification study of the control technology for the photovoltaic power generation system connected to an electric system has been carried on since 1980. A report is made on the construction of verification study facilities and the experiments performed in 1986 and 1987. Outlines are introduced of the basic design of the test field function, field design of the test field, simulated power distribution facility, photovoltaic power generation facility, and measurement control equipment. Integrated power quality test were performed by the verification operation test of the part of the 40kW facility built in 1986 and by the 200kW facility. The mean generating rate was about 6.9% in 4 months for the average of 20 units which was close to the plan. The power generation efficiency of the array was lower by approximately 10% than the average value of unit module measured at the factory. 28 figures, 1 table.

1407 Solar Thermal Power Systems

Refer also to citation(s) 52112

52113 (N–89-23516) **Solar dynamic power for space station freedom.** Labus, T.L.; Secunde, R.R.; Lovely, R.G. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1989. 24p. (NASA-TM–102016;E–4730;NAS–1.15:102016;CONF-8906169–: International Astronautics Federation conference on space power, Cleveland, OH (USA), 5-7 Jun 1989). Available from NTIS, PC A03/MF A01.

The Space Station Freedom Program is presently planned to consist of two phases. At the completion of Phase 1, Freedom's manned base will consist of a transverse boom with attached manned modules and 75 kW of available electric power supplied by photovoltaic (PV) power sources. In Phase 2, electric power available to the manned base will be increased to 125 kW by the addition of two solar dynamic (SD) power modules, one at each end of the transverse boom. Power for manned base growth beyond Phase 2 will be supplied by additional SD modules. Studies show that SD power for the growth eras will result in life cycle cost savings of $3 to $4 billion when compared to PV-supplied power. In the SD power modules for Space Station Freedom, an offset parabolic concentrator collects and focuses solar energy into a heat receiver. To allow full power operation over the entire orbit, the receiver includes integral thermal energy storage by means of the heat of fusion of a salt mixture. Thermal energy is removed from the receiver and converted to electrical energy by a power conversion unit (PCU) which includes a closed brayton cycle (CBC) heat engine and an alternator. The receiver/PCU/radiator combination will be completely assembled and charged with gas and cooling fluid on Earth before launch to orbit. The concentrator subassemblies will be pre-aligned and stowed in the orbiter bay before launch. On orbit, the receiver/PCU/radiator assembly will be installed as a unit. The pre-aligned concentrator panels will then be latched together and the total concentrator attached to the receiver/PCU/radiator by the astronauts. After final electric connections are made and checkout is complete, the SD power module will be ready for operation.

52114 **Transient performance evaluation of an integrated heat pipe-thermal storage system.** Keddy, E. (Los Alamos National Lab. (US)); Sena, J.T.; Merrigan, M.; Heidenreich, G.; Johnson, S. vp of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y American Society of Mechanical Engineers, New York, NY (1988). (CONF-880702–: 23. intersociety energy conversion engineering conference, Denver, CO (USA), 31 Jul - 5 aug 1988).

Technical Paper 889135.

Transient performance tests of an integrated heat pipe-thermal storage system have been conducted. This system was developed as a part of an Organic Rankine Cycle-Solar Dynamic Power System receiver for future power systems. The integrated system consists of potassium heat pipe elements that incorporate thermal energy storage canisters with the vapor space and an organic fluid (toluene) heater tube used as the condenser region of the heat pipe. The transient performance tests determined the operating pipe-thermal storage unit under conditions corresponding to reacquisition of the sun during emergence from eclipse conditions and to the initial start-up of the solar dynamic power system. The test demonstrated that the heat pipe-thermal storage element is not limited under conditions corresponding to emergence from eclipse during normal orbital operations and the heat pipe will successfully start-up from the frozen condition with full input power at the onset. Details of the test procedures and results of the tests are presented in this paper.

1408 Ocean Energy Systems

Refer also to citation(s) 52580

1409 Solar Thermal Utilization

Refer also to citation(s) 52054, 52438

52115 (ETDE-IT–89-04) **Multi-story low-energy consumption buildings.** Funaro, G.; D'Errico, E. Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Dipt. Fonti Alternative Rinnovabili e Risparmio Energetico. Jun 1988. 5p. (CONF-880615–7: Solar '88: American Solar Energy Society annual meeting, Cambridge, MA (USA), 17-24 Jun 1988). Order Number DE89793121. Available from NTIS (US Sales Only), PC A02/MF A01.

In the last ten years, passive solar technologies, mostly centered on multi-story residential buildings located in high density areas, have been experimented in Italy. Bioclimatic design criteria and passive technologies have demonstrated substantial energy savings but with very high extra costs (40 to 50% of traditional construction costs). In particular, the results of this experimentation have shown the difficulties of the massive use of only passive solar technologies in Italian buildings and, in particular, in low cost public housing. The possibility of substituting the 'bioclimatic house' has been studied. Building design should not always be based on the integration of solar technologies alone. Benefits could also be derived from the efficacious use of energy conservation materials and devices such as

thermal insulation and centralized thermal regulation systems. The aim of this study is to verify the feasibility of obtaining 30% energy savings (with respect to the traditional building), at an extra cost of less than 10% (of the standard construction cost), for residential, low-cost multi-story buildings.

52116 (IEIE–8802, pp. 4) **Characteristics of light source for solar simulator and solar simulator for evaluation of solar heat-collector function.** Higashi, Tadatoshi (Toshiba Research and Development Center, Knagawa (Japan)). Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related to electricity and information.* Available from NTIS (US Sales Only), PC A02/MF A01.

The first problem in the design of a solar simulator is the selection of the light source. A report is made on the design of a solar simulator for the evaluation of solar heat collector function. The basic characteristics required for the light source are; the ability to approximate the spectral energy distribution to that of the air mass 2 sunlight in the range from visible wavelength to the infrared ray wavelength of about 2.5μm; high intensity spot light source which provides highly parallel light together with a reflecting mirror; and the ability to provide high luminance of approximately maximum 1,000W/m^2 radiance. 3 kinds of lamps can meet the requirements, i.e., short arc xenon lamp, halogen lamp, and short arc metal halide lamp. Detailed description is made on the solar simulator which employs the designed short arc metal halide lamp. Brief reports are made on the cases where short xenon lamps and halogen lamps are used. 2 references, 13 figures.

52117 (SAND–89-1968) **Solar Industrial Process Heat Project: Final report.** Stine, W.B. Sandia National Labs., Albuquerque, NM (USA). Aug 1989. 145p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. Order Number DE90000922. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

This document contains a report of the work performed in the Solar Industrial Process Heat Project during the period FY 1984 to FY 1986. The work involved seventeen experiments funded by the Department of Energy. The report contains a description of each of the active experiments and a discussion of their system performance, operation, and maintenance experience during the last three years of the project. Emphasis is placed on energy production and on economic considerations. It also contains a brief statement of the status of the solar equipment for systems no longer in operation. The project was sponsored by the Systems Test and Evaluation Branch of the Division of Solar Thermal Technology, Department of Energy. 24 refs., 35 figs., 24 tabs.

1410 Solar Collectors and Concentrators

52118 (N–89-24451) **Isotopic study of oxygen diffusion in oxide coatings.** Gulino, D.A.; Kren, L.A.; Dever, T.M. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1989. 13p. (NASA-TM–102082;E–4764;NAS–1.15:102082;CONF-890468–: 16. international conference on metallurgical coatings and equipment exhibit, San Diego, CA (USA), 17-21 Apr 1989). Available from NTIS, PC A03/MF A01.

Diffusion of oxygen in thin films of silicon dioxide was studied using oxygen isotopically enriched in oxygen of atomic mass 18 (O-18). This subject is of interest because thin films of dielectrics such as SiO2 are proposed for use as a protective coatings for solar mirrors in low Earth orbit, which is a strongly oxidizing environment. Films of this material were prepared with a direct current magnetron using reactive sputtering techniques. To produce (O-18)- enriched SiO2, a standard 3.5-in.-diameter silicon wafer was reactively sputtered using (O-18)-enriched (95 percent) oxygen as the plasma feed gas. The films were characterized using Rutherford backscattering and Secondary Ion Mass Spectrometer (SIMS) to establish stoichiometry and purity. Subsequently, the films were exposed to an air-derived oxygen plasma in a standard laboratory plasma reactor for durations of up to 10 hr. The concentration ratio of O-16 as a function of depth was determined using SIMS profiling and compared to a baseline, nonplasma exposed sample. A value for the diffusivity of oxygen near the surface of these films was obtained and found to be about 10(-15)sq cm/sec.

52119 (N–89-24704, pp. 286-291) **Domed Fresnel lens concentrator technology for space application.** Piszczor, M.F. Jr. (ENTECH Corp., Dallas-Fort Worth Airport, TX (USA)); Oneill, M.J. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. (NASA-CP–3030;E–4587;NAS–1.55:3030;CONF-8804122–: 9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology, Cleveland, OH (USA), 19-21 Apr 1988). In *Space photovoltaic research and technology, 1988. High efficiency, space environment, and array technology.* Available from NTIS, PC A16/MF A01.

Over the past three years, NASA Lewis and Entech, Inc. have been investigating the use of high efficiency refractive photovoltaic concentrators for use in space. The design currently under investigation uses a square domed Fresnel lens to focus light on a GaAs concentrator cell. A prismatic cell cover, which directs light away from the front contacts and thus eliminates metalization losses, is applied to the top of the GaAs cell to further enhance array efficiency. The latest experimental results based on testing the GaAs cell/prism cover assembly at standard and operating conditions are presented.

1420 Heat Storage

Refer also to citation(s) 52364

15 GEOTHERMAL ENERGY

52120 (NEDOJ–8809, pp. 187-198) **Status quo of the Geothermal Energy Division.** Kato, Shoroku (New Energy Development Organization, Tokyo (Japan)). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the 8th NEDO General Assembly.* Available from NTIS (US Sales Only), PC A23/MF A01.

NEDO has the Geothermal Investigation Department and the Technology Development Office in the Investigation Department as its geothermal division. The Geothermal Investigation Department has been carrying on promotional investigation for geothermal development, development of geothermal reservoir evaluation methods, conceptional design of small-to-medium geothermal systems, and verification studies such as overall investigation of geothermal energy throughout Japan. The budgets for the department in 1987 and 1988 are shown. The Geothermal Technology Department Office is carrying on the development of power generating plant utilizing hot water, technological development of hot dry rock generating system, and the development of highly precision geomagnetic current method of prospecting technology. In 1987, the office developed a 10 MW class plant and a downhaul pump, investigated reinjection mechanism of hot water, and developed the optimum production method for hot water. To meet the requirements for investigation accompanying field operation, the Investigation Department has local offices under its direct control, for operational control, local correspondence, etc., with 12 offices dispersed from Hokkaido to Kyushu areas. 1 table.

1501 Resource Status and Assessment

Refer also to citation(s) 52124, 52125

1503 Geothermal Exploration and Exploration Technology

Refer also to citation(s) 53575

52121 (DOE/EA–0410) **Geothermal temperature gradient core drill, Santiam Pass.** USDOE Assistant Secretary for Environment, Safety and Health, Washington, DC (USA). Office of NEPA Project Assistance. [1989]. 38p. Sponsored by U.S. DOE Environment Health & Safety. Order Number DE90001112. Available from NTIS, PC A03/MF A01 - OSTI.

DOE is proposing to share in the cost of drilling a 3000-ft core hole to evaluate temperature gradients, subsurface geology and the geothermal potential of an area in the Cascade Mountains. The proposed core hole will be located in the Deschutes National Forest in Oregon, near Santiam Pass. The proposed action has been described in the Environmental Assessment (EA) for Geothermal Temperature Gradient Core Drill Santiam Pass Area (No. OR-050-9-51) prepared by the US Bureau of Land Management (BLM). DOE has determined that the BLM EA adequately addresses the impacts of the proposal and is hereby adopting the EA in partial fulfillment of its NEPA responsibilities. Based upon a review of the EA and an independent analysis, DOE has concluded that the proposed core-hole drilling project does not constitute a major federal action significantly affecting the quality of the human environment within the meaning of NEPA. Therefore, an environmental impact statement will not be prepared.

52122 (GRSJ–8901, pp. 569) **Exploration and development of geothermal water resources for agricultural use in Japan.** Wada, M. (Agricultural Structure Improvement Bureau, Tokyo (Japan)); Tomono, T. Geothermal Research Society of Japan, Tsukuba (Japan). 10 Nov 1988. (CONF-881170–: International symposium on geothermal energy, Kumamoto (Japan), 10-14 Nov 1988). In *Exploration and development of geothermal resources.* Order Number DE89782366. Available from NTIS (US Sales Only), PC A99/MF A01.

In 1980, Agricultural Structure Improvement Bureau, MAFF initiated Geothermal Water Exploration Project series to promote the agricultural use of geothermal resources. The purpose of the project series is to exploit geothermal resources for agricultural uses where a considerable extent of farm land is present and where the utilization of geothermal energy for agriculture has not been active so far, however, is fairly probable in the near future. The operation term of one project is three years and one project covers two or three prefectures. As of 1988, three projects have completed and three are in operation. During the operation period, extensive geological and geophysical data are collected and examined in the first year. In the subsequent two years, two drillings are carried out at two promising sites which are found through geological surveying, gravity anomaly measurements, radioactive and geochemical prospecting and so on. Although agricultural uses of geothermal resources still have many technical problems and are affected by economic circumstances, the project series are promoted to help improving the productivity of agriculture.

52123 (NEDOJ–8809, pp. 199-213) **Investigation for the promotion of geothermal development.** Maki, Hiroyuki (New Energy Development Organization, Tokyo (Japan)). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the 8th NEDO General Assembly.* Available from NTIS (US Sales Only), PC A23/MF A01.

NENO is conducting an investigation to promote geothermal development since 1980 to encourage enterprises to expedite investigation and devlopment of geothermal power generation in promising areas for geothermal resources where they hesitate to start investigation because of exploration risk. The areas totaled 29. The result and current status of the geothermal development promotion are shown in tables. NEDO developed geothermal reservoir evaluation method as Phase I in 4 years from 1984 to 1987. Phase II will start in 1988. Results of the development of simulators, excavation of observation wells, lengths of boreholes, simulation for reservoir layers are reported. The result is scheduled to be publicized in 1988. A simplified small-to-medium scale geothermal generation equipment was designed, constructed and trially tested to study its applicability. In addition, model plans for small-to-medium scale geothermal systems were worked out for areas of a variety of applications. 8 figures, 4 tables.

52124 (NEDOJ–8809, pp. 214-226) **Overall investigation of geothermal resources throughout Japan.** Noda, Tetsuro (New Energy Development Organization, Tokyo (Japan)). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the 8th NEDO General Assembly.* Available from NTIS (US Sales Only), PC A23/MF A01.

The objective of this investigation is to develop an integrated analytical method to efficiently extract promising geothermal areas by analyzing ground surface data, with a resource evaluation system applying advanced data processing technique as its core. To acquire various data required for the purpose, investigation of ground surface is carried out in areas having specifically promising volcanic hot water convection systems. Research and development were made for such subsystems as the information network system comprising integrated analytic system, computer mapping system, and resource evaluation system. Tokachi, Nasu and Tsurumitake, the areas which were found promising by the secondary investigation, were selected for the wide area hot water flow investigation to study the distribution of volcanic rocks, epochs, geochemical analysis of fluid, precision gravity, and specific resistance. The summary of the result is reported. 8 figures.

52125 (NEDOJ–8809, pp. 227-244) **Verification study of geothermal prospecting technology.** Noda, Tetsuro (New Energy Development and Industrial Technology Organization, Tokyo (Japan)). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessins for the 8th NEDO General Assembly.* Available from NTIS (US Sales Only), PC A23/MF A01.

The objective of this study is to establish prospecting technology applicable to the exploration of deep geothermal resources in wide area to expedite the development. In 2 model areas, the conditions of geothermal resources were estimated by various geothermal prospecting techniques, and the result was verified by comparison with the investigated result of wells. A deep vefification well was drilled in Sumikawa district in the north of Sengan Area to carry out investigation of wells such as examination of layers, analysis of rock cores, etc. Correlation of geothermal structures was analyzed basing on the existing borehole data and ground surface data in Kurikoma Area, and statistical case studies were made for areas with similar geothermal type in Japan. The existing prospected data and the analyzed data were arranged, converted into numerical values, and reprocessed for comparision with data of the ground surface, borehole and MT method. Except for a part of the data, factors accurately representing geothermal phenomenon were obtained to indicate that every one of the methods was effective. 12 figures, 2 tables.

52126 (NEDOJ–8809, pp. 262-288) **Development of geothermal prospecting technology. Development of prospecting technology for high precision magneto-telluric prospecting method.** Takasugi, Shinji (Geothermal Energy Research and Development Co., Ltd., Tokyo (Japan)). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the 8th NEDO General Assembly.* Available from NTIS (US Sales Only), PC A23/MF A01.

Although there are many kinds of geophysical prospecting methods for geothermal prospecting, the objective of this project is to develop the measurement system called magneto-telluric prospecting method (MT method) which constitutes a part of the Sunshine Project. The history and result up to now of the development of the portable instantaneous 4 survey point triple collation processing MT prospecting technology are reported. The MT method has been applied not only to the estimation of geothermal fluids but also for the estimation of reservoir structure. Development of technologies for measurement, data processing, and analysis as well as the development of analytic programs are making satisfactory progress. The system is of far more compact portable type than the conventional system, enabling easier access to survey points. It was confirmed that more accurate data can be obtained by the developed 4 survey point triple collation processing than those by 2 survey point duplex collation processing. The system was envaluated to be the best in the world at this moment. 17 figures, 6 tables.

1506 Environmental Aspects and Waste Disposal

52127 (PB–89-198089/XAB) **Influence of geothermal sources on deep ocean temperature, salinity, and flow fields. Doctoral thesis.** Speer, K.G. Woods Hole Oceanographic Institution, MA (USA). Jun 1988. 150p. (WHOI–88-23). Available from NTIS, PC A07/MF A01.

The thesis studies the effect of geothermal sources on the deep circulation, temperature and salinity fields. In Chapter 1 background

material is given on the strength and distribution of geothermal heating. In Chapter 2 evidence for the influence of a hydrothermal system in the rift valley of the Mid-Atlantic Ridge on nearby property fields and a model of the flow around such a heat source are presented, with an analysis of a larger-scale effect. Results of an analytical model for a heat source on a Beta-plane in Chapter 3 show how the response far from the source can have a structure different from the forcing because of its dependence on two parameters: a Peclet number (the ratio of horizontal advection and vertical diffusion), and a Froude-number-like parameter (the ratio of long wave phase speed to background flow speed) which control the relative amount of damping and advection of different vertical scales. The solutions emphasize the different behavior of a dynamical field like temperature compared to tracers introduced at the source. These ideas are useful for interpreting more-complicated solutions from a numerical model presented in the final chapter.

1508 Geothermal Power Plants

52128 (NEDOJ–8809, pp. 245-261) **Development of power-generation technology utilizing hot water. Investigation of reinjection mechanism of geothermal water.** Shinohara, Nobuo (New Energy Development and Indastrial Technology Organization, Tokyo (Japan)). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the 8th NEDO General Assembly.* Available from NTIS (US Sales Only), PC A23/MF A01.

The objective of this project is to carry out research and experiment necessary for the establishment of the optimum production reinjection sytem to investigate a reinjection system which will have no trouble even a large amount of geothermal water is reinjected. The research and experiment have been carried on, with the site transferred to Onikobe area in 1985. The result of the investigation up to 1987 is reported. The subjects of the investigation were arrangement of existing data, investigation of current status by borehole and storage layer experiments, test with tracer, borehole tracking, and study by simulation. A simulation for model making was prepared in 1986, and the model was restudied in 1987. The observed values at the observation well for every ten days in the past 2 years are compared with the total production, amount of reinjection and precipitation at the Onikubi power plant. In the tracer test, KI(potassium iodide) and KBr (Potassium bromide) were projected into two wells at the same time, and the gush was investigated for the succeeding 90 days at all the production wells. 8 figures, 6 tables.

1509 Geothermal Engineering

Refer also to citation(s) 51717

52129 **Use of single-cutter data in the analysis of PDC bit designs.** Glowka, D.A. (Sandia National Labs. (US)). *Journal of Petroleum Technology (USA),* 41(8): 797-849 (Aug 1989).

Research has been conducted for several years at Sandia Natl. Laboratories to foster the development of PDC bits for geothermal drilling. This work has been directed toward the high-temperature, hard-rock drilling environment typically found near geothermal resources. The results, however, can be applied to drilling environments of interest to the petroleum industry as well. Designing and operating PDC bits to perform effectively within the constraints suggested by these wear phenomena are the subjects of this paper. Part 1 presents laboratory work that provides insight and quantitative data on cutter/rock interaction. A cutter-interaction model based on the laboratory results is developed and shown to provide a means for predicting the effects of multiple cutters on a PDC bit face. In Part 2, this model is generalized and used to develop algorithms for a computer code (PDCWEAR) that predicts the performance and wear of PDC drill bits. General trends related to the effects of bit design and operation, as predicted by the code, are also identified and discussed.

1520 Geothermal Data and Theory

52130 **Rare-earth elements in hot brines (165 to 190°C) from the Salton Sea geothermal field.** Lepel, E.A.; Laul, J.C.; Smith, M.R. *Transactions of the American Nuclear Society (USA),* 56: 226-228 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Rare-earth element (REE) concentrations are important indicators for revealing various chemical fractionation processes (water/rock interactions) and source region geochemistry. Since the REE patterns are characteristic of geologic materials (basalt, granite, shale, sediments, etc.) and minerals (K-feldspar, calcite, illite, epidote, etc.), their study in geothermal fluids may serve as a geothermometer. The REE study may also enable us to address the issue of groundwater mixing. In addition, the behavior of the REE can serve as analogs of the actinides in radioactive waste (e.g., neodymium is an analog of americium and curium). In this paper, the authors port the REE data for a Salton Sea Geothermal Field (SSGF) brine (two aliquots: port 4 at 165°C and port 5 at 190°C) and six associated core samples.

17 WIND ENERGY

1706 Wind Energy Engineering

52131 (FRNC-TH–3476) **Mechanical and aerodynamical study of Savonius-type vertical axis wind turbines.** Chauvin, A. Aix-Marseille-1 Univ., 13 - Marseille (France). 1987. 182p. (In French). Order Number DE90713658. Available from NTIS (US Sales Only), PC A09/MF A01.

Experimental measures of the pressure on a Savonius type wind rotor are presented. The rotor CM and CP mechanical coefficients are derived. Then, the blade pressure field have been determined and used to calculate the moment and power coefficient and the drag and lift coefficients. Vizualisations of the vortex emission near the wind turbine are presented. Various suspension systems for the vibration isolation of a three-blade Proengin-type wind turbine are also studied.

52132 (PB–89-210579/XAB) **Recommended practices for testing water-pumping windmills. Technical paper.** Veldkamp, D. International Bank for Reconstruction and Development, Washington, DC (USA). 1989. 41p. (WORLD-BANK-TP–100). Available from NTISMF A01.

Library of Congress catalog card No. 89-9107; Microfiche copies only. Paper copy available from World Bank, 1818 H St., NW, Washington, DC 20433.

The report contains the test standards for windpump testing on test sites.

52133 (SAND–89-0986C) **Control of the variable speed generator on the Sandia 34-metre vertical axis wind turbine.** Ralph, M.E. Sandia National Labs., Albuquerque, NM (USA). [1989]. 11p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. (CONF-890981–2: Windpower '89, San Francisco, CA (USA), 24-27 Sep 1989). Order Number DE90000803. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The DOE/Sandia 34-metre VAWT Test Bed is a 500kW variable-speed wind turbine. The turbine is operated between 25 and 38 rpm and has been characterized from a structural and aerodynamic stand point. A preliminary variable speed control algorithm has been implemented on the Test Bed. This paper describes the initial variable-speed control algorithm developed for the Test Bed and the performance of that algorithm to date. Initial performance comparisons between variable-speed and fixed-speed operation are made as well as some thoughts on the expansion of the operating envelope of the Test Bed. 7 refs., 4 figs.

52134 (SAND–89-1396) **Reference manual for the LIFE2 computer code.** Schluter, L.L.; Sutherland, H.J. Sandia National Labs., Albuquerque, NM (USA). Sep 1989. 160p. Sponsored by

U.S. DOE Management & Administration. DOE Contract AC04-76DP00789. Order Number DE90000958. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

LIFE2 is a PC-compatible computer code that analyzes the service lifetime of a WECS component. The LIFE2 code is written in Fortran and has the option of using either a fatigue analysis or a linear fracture mechanics analysis. This document contains information on what the code expects as input and what can be expected as output from the code. Also included are two example problems. 11 refs., 9 figs., 1 tab.

52135 (SAND–89-1535C) **Test results and status of the DOE/Sandia 34-m VAWT Test Bed.** Dodd, H.M.; Ashwill, T.D.; Berg, D.E.; Ralph, M.E.; Stephenson, W.A.; Veers, P.S. Sandia National Labs., Albuquerque, NM (USA). 1989. 20p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. (CONF-8909217–1: Canadian Wind Energy Association conference, Charlottetown (Canada), 18-21 Sep 1989). Order Number DE90000810. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The DOE/Sandia 34-m VAWT Test Bed has been fully operational for over a year. During that time extensive performance data have been gathered. This paper first briefly discusses the background and evolution of this research turbine and its testing philosophy. Next, specific results are presented in the areas of aerodynamics, structural dynamics, and operation and control. The aerodynamics section primarily discusses measured versus predicted output power. In the structural dynamics section turbine response is presented with results shown for rotating natural frequencies and stresses at critical (blade) locations. Finally, operation and control results are presented, which include normal start/stop, speed variation, emergency handling and power quality issues. 16 refs., 11 figs., 1 tab.

20 ELECTRIC POWER ENGINEERING

2001 Power Plants and Power Generation

Refer also to citation(s) 51645, 51650, 51651, 51652, 51677, 51703, 52040, 53281

52136 (CONF-8904156–40) **Fire risk in a conventional power plant: the maintenance viewpoint.** Prelati, M.; Salvaterra, G.; Soressi, G. Nuclear Energy Agency, 75 - Paris (France). Committee on the Safety of Nuclear Installations; Commission of the European Communities, Brussels (Belgium). 1989. 12p. From CSNI-CEC specialist meeting on trends and pattern analyses of operational data from nuclear power plants; Rome (Italy); 3-7 Apr 1989. Order Number DE89793107. Available from NTIS (US Sales Only), PC A03/MF A01.

In oil fired conventional power plants, the risk of fire is one of the crucial safety problems. An accidental oil leakage from the pipeline leading to the burner system may get the fuel in contact with high temperature plant parts, and give rise to fire. This paper deals with the problem of preventing an accidental oil leakage from the piping system. Reference is made to a large electric power plant. Some proposals are given for changing maintenance procedures in order to minimize the probability of such event.

52137 (EPRI-CS–5581-SR, pp. 5.147-5.164) **Investigation of alloys for advanced steam cycle superheaters and reheaters.** Swindeman, R.W. (Oak Ridge National Lab., TN (USA)); Judkins, R.R.; Bradley, R.A. Electric Power Research Inst., Palo Alto, CA (USA). 1988. DOE Contract AC05-84OR21400. (CONF-8611272–: 1. international conference on improved coal-fired power plants, Palo Alto, CA (USA), 19-21 Nov 1986). In *First international conference on improved coal-fired power plants: Conference proceedings*. Order Number DE89003035. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

A plan is described for the investigation of candidate alloys for advanced steam cycle superheaters and reheaters. The plan identifies performance criteria, including strength, weldability, metallurgical stability, fireside corrosion resistance, and steamside corrosion resistance, and outlines an approach by which the most promising alloys will be selected for detailed studies. Alloys falling into the austenite phase field at 650°C are potentially the most stable, and the lean stainless steels typified by 17-14CuMo stainless steel appear to have good strength and fabricability. Such alloys need to be protected on both the fireside and steamside for service in 650°C advanced steam systems. Higher chromium- and nickel-containing alloys such as alloy 800H may have adequate steamside corrosion resistance, but are marginal in regards to strength. Strength may be improved but at some risk to ductility and fabricability. Again, protection is required on the fireside. Greater efforts are needed to examine the potential of aluminum-containing alloys. Here fabricability is a major concern, and exploratory studies are needed. The development of high-chromium nickel-base alloys is well advanced, and these alloys could serve either as cladding or monoalloy tubing.

52138 (EPRI-GS–6422-Vol.1) **Second international conference on improved coal-fired power plants: Conference proceedings, Volume 1.** Armor, A.F.; Bartz, J.A.; Touchton, G.; Valverde A, L.J. Jr. (eds.). Electric Power Research Inst., Palo Alto, CA (USA). c [1989]. 946p. Sponsored by Electric Power Research Institute. (CONF-881133–Vol.1: 2. international conference on improved coal-fired power plants, Palo Alto, CA (USA), 2-4 Nov 1988). Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The conference covered developments around the world in fossil-fuel power plant technologies, including advances in boiler and turbine design, materials, controls, and emerging technologies such as fluidized-bed combustion and integrated gasification/combined-cycle. These proceedings include 81 papers from the following sessions: National and Institutional Programs, Power Plants: Standard and Modular Construction, Power Plants: Advanced Concepts, Boiler Design, Boiler Materials, Turbine Design, Turbine Materials, Advanced Plant Controls, Balance-of-Plant Equipment, and Environmental Controls. Individual projects are processed separately for the data bases.

52139 (EPRI-GS–6422-Vol.2) **Second international conference on improved coal-fired power plants: Conference proceedings: Volume 2.** Armor, A.F.; Bartz, J.A.; Touchton, G.; Valverde A, L.J. Jr. (eds.). Electric Power Research Inst., Palo Alto, CA (USA). c 1989. 691p. Sponsored by Electric Power Research Institute. (CONF-881133–Vol.2: 2. international conference on improved coal-fired power plants, Palo Alto, CA (USA), 2-4 Nov 1988). Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Research programs, presented at the second international conference on improved coal-fired power plants, are presented. The conference consisted of five sessions: national or institutional programs; power plants; boiler design and materials; turbine design and materials; controls and balance of plant. A combined session on environmental controls was also held. Programs from sessions 4, 5, and environmental controls are presented in this report. Individual projects are processed separately for the data base. (CBS)

52140 (EPRI-GS–6535) **Solid particle erosion of steam turbine components: 1989 workshop.** Murphy, S.R. (ed.). Electric Power Research Inst., Palo Alto, CA (USA); Encor-America, Inc., Mountain View, CA (USA). Sep 1989. 343p. Sponsored by Electric Power Research Institute. (CONF-890326–: Solid particle erosion of steam turbines components workshop, New Orleans, LA (USA), 7-9 Mar 1989). Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

An EPRI workshop to address solid particle erosion of utility steam turbines was held in New Orleans, Louisiana on March 7-9, 1989. This workshop was conducted in conjunction with the ASME Task Force on solid particle erosion. These proceedings contain the text of the formal presentation, as well as questions and answers pertaining to these presentations. Also included are summaries of the working group sessions, results of a questionnaire on SPE, and a summary of the panel discussion. The formal presentations were organized under the following general session titles. Session I: monitoring and diagnostics; Session II: thermal performance and economics; Session III: protective measures; and Session IV: preventative measures. Individual projects are processed separately for the databases.

52141 (EPRI-GS–6566) **Nontoxic foul-release coatings: Final report.** Electric Power Research Inst., Palo Alto, CA (USA); Stone and Webster Engineering Corp., Boston, MA (USA); Battelle Ocean Sciences, Duxbury, MA (USA). c Oct 1989. 114p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The Electric Power Research Institute (EPRI) under project RP-1689-9 evaluated 30 non-toxic coatings for biofouling control on steel and concrete surfaces of cooling water intakes and piping. Seven coatings were evaluated at seven sites for 2 year. The remaining 23 coatings were exposed for a variety of time lengths at the Battelle Marine Laboratory at Daytona Beach, Florida. Accelerated corrosion tests and inspection of the test panels to determine coating life were also conducted. Results of several utility conducted tests were also solicited. Silicone-based coatings performed the best with predicted lives of 2 to 4 year. Although the non-toxic coatings can be fouled by biogrowth, the rate of fouling is less and the coating can be easily cleaned. A cost-benefit methodology is presented to aid utilities to assess the potential use of non-toxic foul-release coatings at power plant cooling systems. 12 refs., 16 figs., 35 tabs.

52142 (ETDE-IT–89-09) **The computation of hydraulic transients in condenser cooling water circuits as a mass-oscillation phenomenon.** Fanelli, M.; Reali, M.; Dassie, G. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Aug 1987. 17p. (CONF-8709452–1: 8. international round table on hydraulic transients in power stations, Madeira (Portugal), 14-17 Sep 1987). Order Number DE89793125. Available from NTIS (US Sales Only), PC A03/MF A01.

In this study, a synthetic analysis of a previously developed mass-oscillating model (MOM) of hydraulic transients in power stations is given with the view of providing a framework for related numerical applications. A simplified one-pump, one-pipe, one-condenser hydraulic circuit is singled out as being of special interest for guiding design work. The MOM fluid dynamic equations pertaining to the successive stages of cavity evolution with subsequent development of hydraulic transients are presented together with some numerical solutions obtained by a specific, very simple, accurate and fast computer code (Traid).

52143 (IEIE–8801, pp. 143-146) **Totally automated power facilities at present and in the future.** Tobo, Shigeharu (Chubu Electric Power Co. Inc., Nagoya (Japan)). Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). In *1988 joint convention record of institutes of electrical and information engineers, Japan (part 1).* Available from NTIS (US Sales Only), PC A09/MF A01.

This paper outlines the electric power automation project which Chubu Electric Power Co., Inc. is implementing. Subjects covered are as follows: (1) Present situation - an overview of the electric power facility automation project phase (1) which started in 1972 and entered the stage of operation in July, 1977 is explained; the discussion here covers the control system, combination of control and distribution stations, the system configuration and functions of control stations, and maintenance stations, and branch offices. (2) Problems and themes at present. (3) Outlook - the electric power facility automation project (phase 2 and its points are discussed, focusing on what should be that project). 3 references, 3 figures, 2 tables.

52144 (IEIE–8801, pp. 147-150) **New concept of electric power system control.** Takahashi, Kazuhiro (Central Research Institute of Electric Power Industry, Tokyo (Japan)). Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). In *1988 joint convention record of institutes of electrical and information engineers, Japan (part 1).* Available from NTIS (US Sales Only), PC A09/MF A01.

This paper outlines the concept of online reliability control which is a control method assuring a high security required for running huge power systems in the future and which uses a coordinated distribution (self-contained distribution) method and suggests the use of this control. Subjects covered are as follows: (1) What electric power system control should be – the themes discussed here are why reliability control is necessary, what is expected of reliability control, and what is the situation surrounding reliability control. (2) Self- contained distribution of electric power systems – the themes discussed here are why self-contained distribution is necessary, what is self-contained distribution, what is the concept of self-contained distributed power systems, and what effect will be produced from the use of self-contained distribution. (3) Configuration of control information system – the themes discussed here are the information network which interconnects distributed establishments through broadcast-type information transmission paths and the control processor and database which are used for operations based on coordination theory. (4) Problems to be solved. 2 references, 1 figure, 4 tables.

52145 (ORNL/FTR–3410) **[The status of advanced combustion for electric power generation from coal]: Foreign trip report, October 7, 1988–September 29, 1989.** Rodgers, B.R. Oak Ridge National Lab., TN (USA). 13 Oct 1989. 11p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC05-84OR21400. Order Number DE90001576. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler was seconded to the IEA-Coal Research at its London, U.K. office, for the purpose of writing a report covering the status of advanced combustion for electric power generation from coal. The Executive Committee of the IEA-Coal Research, consisting of a representative from each of the 14 member countries, are currently reviewing the report, which was completed on time. The report includes a discussion of techniques, such as integrated gasification combined cycle (IGCC), pressurized fluidized-bed combustion (PFBC), and circulating fluidized-bed combustion, coupled with the latest gas turbine technology.

52146 (ORNL/Sub–88-SA798/01) **Potential applications of structural ceramic composites in gas turbines: Final report.** Parks, W.P. Jr.; Ramey, R.R.; Rawlins, D.C.; Price, J.R.; van Roode, M. Oak Ridge National Lab., TN (USA); Babcock and Wilcox Co., Lynchburg, VA (USA). Research and Development Div. Sep 1989. 205p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC05-84OR21400. 87X-SA798V. Order Number DE90001273. Available from NTIS (US Sales Only), PC A10/MF A01 - OSTI; GPO Dep.

A Babcock and Wilcox-Solar Turbines Team has completed a program for MMES on assessing the potential for structural ceramic composites in turbines for direct coal-fired or coal gasification environments. A review is made of the existing processes in direct coal firing, pressurized fluid bed combustors, and coal gasification combined cycles. Materials requirements in these areas are also assessed. The program examines the state-of-the-art in ceramic composites materials and the most promising materials for use in coal-fired turbines are identified. These materials are based upon Al_2O_3, ZrO_2, Si_3N_4, SiC, or glass ceramics. Use of ceramic composites could produce performance and efficiency gains within the turbine. Utilization of ceramic composites in the rotor blades and nozzles vanes would provide the most benefit to the turbines. A research program designed to introduce ceramic composite components to these turbines was recommended. 157 refs., 79 figs., 40 tabs.

52147 (PNL–7104) **Effects of filament-matrix interfaces on the mechanical properties of SiC-reinforced Si_3N_4: A review.** Schilling, C.H. Pacific Northwest Lab., Richland, WA (USA). Sep 1989. 62p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC06-76RL01830. Order Number DE90001863. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This report summarizes the results of a literature review of the effects of filament-matrix interfaces on the mechanical properties of ceramic composites composed of SiC-filament-reinforced Si_3N_4. A general review of the processing and mechanical properties of SiC-filament-reinforced Si_3N_4 is presented with special emphasis on research pertaining to processing-related effects on filament-matrix interfaces and the resulting effects of these interfaces on fracture behavior. A review of coating techniques for ceramic filaments is also presented, and recommendations are made for future directions in processing SiC-filament-reinforced Si_3N_4 with mechanical properties that are enhanced by the microstructure of the filament-matrix interface. 148 refs., 1 tab.

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Refer also to citation(s) 51676, 51677, 51680, 51695, 52139, 52157, 52158

52148 (DOE/EA–0331) **Buffalo Flat service, 115-kV transmission project: Environmental assessment.** USDOE Bonneville Power Administration, Portland, OR (USA). Office of Engineering and Construction. Jul 1987. 55p. Sponsored by U.S. DOE Environment Health & Safety. Order Number DE90001106. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

BPA, in conjunction with Midstate Electric Cooperative (Midstate), proposed to construct two sections of a new 115-kV transmission line in central Oregon: one section from BPA's LaPine Substation to Midstate's Fort Rock Substation (BPA), and the other from Fort Rock Substation to the proposed US Air Force radar transmitter site at Buffalo Flat (Midstate). The proposed line would be a total of about 74 miles long, and of either wood or steel single-pole construction; it would parallel existing corridors and/or roads for much of the distance. 23 refs., 6 figs., 5 tabs.

52149 (DOE/PC/88867–T4) **Electrostatic precipitation of condensed acid mist: Fourth quarterly technical progress report, June 1–August 31, 1989.** Southern Research Inst., Birmingham, AL (USA). 1989. 15p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88867. (SRI-ENV–89-826-6657-XV). Order Number DE90001159. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The purpose of this project is to develop and demonstrate a compact, wet electrostatic collector for condensed acid mist in power plant flue gas. The following are project objectives: (1) fabrication of laboratory-version of the WESP; (2) optimization of the WESP performance through laboratory tests with a non-volatile simulant aerosol having a size distribution similar to the acid mist; (3) demonstration of adequate collection of actual acid mist in a pilot coal combustion facility under conditions simulating full-scale power plant burning high-sulfur coal; (4) development of computer model of the WESP process must be developed to assist in the process optimization, interpretation of test results, and extrapolation to full scale; and (5) solicitation of utility participation in a follow-on demonstration of the WESP concept at a full-scale power plant. The WESP fabrication, laboratory and pilot combustor testing, and computer modeling is discussed. 5 refs., 5 figs.

52150 (ENEA-DOC-DISP–87-4) **ENEL Tavazzano-Montanaso (Italy) fossil-fuel power plant: report on environmental compatibility.** ENEA, Rome (Italy). Direzione Sicurezza Nucleare e Protezione Sanitaria. Feb 1987. 16p. (In Italian). Order Number DE89793017. Available from NTIS (US Sales Only), PC A03/MF A01.

The planned ENEL (Italian Electricity Board) Tavazzano-Montanaso fossil-fuel power plant (with poly-fuel boilers which can run on fuel oil, coal or methane) is analyzed for its environmental compatibility - the plant's ability to deal with problems associated with desulfurization of flue gas and the formation of acid rain. Reference is made to national and international pollution standards. Socio-economic factors are also taken into consideration. In addition to satisfying emission standards, the plant's design calls for the setting up of extensive air pollution monitoring networks, on and off-site.

52151 (Juel-Conf–64, pp. 41-53) **Flow of catalyst particles in a flue gas desulfurization plant; mass transfer in the domain of a detached flow - two examples (desulfurization, HTGR type reactor) for the application of big computers solving technical problems.** Achenbach, E. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente. Sep 1988. (In German). In *Working report of the Institute of Reactor Components at the KFA Juelich. Scientific lectures of the commemorative colloquium held on September 2, 1987 at the KFA Juelich.* Order Number DE90711187. Available from NTIS (US Sales Only), PC A06/MF A01.

The research work of the Institute for Reactor Components is mainly experimental in character. Where possible, the experiments are accompanied by numerical calculations. This has the advantage of rendering parameter studies faster and more economical than is the case with experiments, so that physical contexts can become more apparent. However, these calculations are no substitute for experiments. The application of numerical calculations in connection with experimental results can now be demonstrated with two examples. The examples have been selected with the aim of making the presentation of the results sufficiently interesting for all those participating at the colloquium. The theoretical and experimental results are presented in the form of short films. (orig.).

52152 (PB–89-207823/XAB) **Supplemental air-quality impact analysis for Easton Utilities Commission Power Plant, No. 2, Units 23 and 24.** Versar, Inc., Columbia, MD (USA). Jun 1989. 24p. Available from NTIS, PC A03/MF A01.

The air-quality dispersion model was used to estimate the impact of emissions from the planned expansion on the ambient air quality of the surrounding community. The modeling examined the impact as it relates to both the National Ambient Air Quality Standards (NAAQS) and the Prevention of Significant Deterioration (PSD) requirements. The model was used to estimate the dispersion of sulfur dioxide (SO_2), particulate matter with diameters less than 10 micrometers (PM10), and nitrogen oxides (NOx).

52153 (PB–89-207955/XAB) **Evaluation of internally staged coal burners and sorbent-jet aerodynamics for combined SO_2/NOx control in utility boilers. Volume 1. Testing in a 10 million Btu/hr experimental furnace. Final report, October 1982-June 1985.** Cetegen, B.M.; Clough, J.; England, G.C.; Johnson, T.R.; Kwan, Y. Energy and Environmental Research Corp., Irvine, CA (USA). Jun 1989. 297p. Available from NTIS, PC A13/MF A01.

This document gives results of tests conducted in a 2-MWt experimental furnace to: investigate ways to reduce NOx emissions from utility coal burners without external air ports (i.e., with internal fuel/air staging); and improve the performance of calcium-based sorbents for SO_2 control, by modifying the design and operation of the sorbent jets. NOx emissions could be reduced by 50-60% (to 300-500 ppm) without external ports by using two secondary air channels in the burner throat, and by modifying the coal nozzle. A baffle in the outer secondary air channel also appears necessary where high secondary air velocities cannot be avoided. Sorbent testing confirmed that jet design/operation must focus on protecting the sorbent from seeing high peak temperatures: a peak temperature of 1230-1290 C gave optimum sorbent performance. SO_2 removals of 80% at Ca/S = 2 were achieved with a pressure-hydrated lime at this temperature. Jet design to increase sorbent heating rate might also have a secondary effect in improving performance.

52154 (UBA-FB–87-092/1.3) **Measurement and assessment of the heavy metal emissions from selected installations and suggested measures for their reduction. Partial report on measurements of the heavy metal and trace element emissions of a brown-coal-fueled power plant boiler.** Luetzke, K.; Sobottka, H. Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen (Germany, F.R.). Zentralabteilung Emissionsmessungen; Umweltbundesamt, Berlin (Germany, F.R.). Oct 1987. 162p. (In German). Contract UFOPLAN-Nr. 10403185. Available from Copy held by UB/TIB Hannover.

For a lignite-fired power station boiler with waste gas dedusting by two parallel electrical precipitators, each with three electric fields, the mass flows of dust, selected heavy metals and trace elements (As, Be, Cd, Cr, Cu, Hg, Mn, Ni, Pb, Se, Te, Tl, V and Zn) which were emitted with the waste gases were determined (As, Cd, Hg and Se also for the gas phase). The measurements were carried out in two periods of almost maximum boiler performance and with firing of coal from 3 different coaling sites. Furthermore, the particle size distribution in pure gas dust - during the first measurement period also in crude gas dust - were determined by impacter measurements. Specific emission factors for the individual elements were calculated, and corresponding balances for the system 'lignite boiler' were prepared. For the heavy metals and trace elements examined in this context, especially for Se, Pb and Tl, distinctively higher concentrations in the waste gas compared with the lignite charge, and parallel concentrations in the range of small size fractions were detected. The medium dust emission amounted to 22.8 kg/h with a 50% value of the particle size distribution in pure gas dust of 3.5-8.0 μm (1st measurement period) respectively 3.1-3.8 μm (2nd measurement period). The highest emission factors referred to 1 t

of lignite amounted to 120 mg of Mn, 48 mg of Hg, 17 mg of Ni, 12 mg of Cr and 12 mg of Pb. (orig.) With 12 refs., 43 tabs., 59 figs.

52155 **Kinetic modeling of artifacts in the measurement of N_2O from combustion sources.** Lyon, R.K. (Energy and Environmental Research Corp., Irvine, CA (US)); Cole, J.A. *Combustion and Flame (USA),* 77(2): 139-144 (Aug 1989).

The N_2O emissions from combustion systems, especially coal-fired utility boilers, has been a matter of increasing concern because N_2O contributes both to the greenhouse effect and to ozone depletion. Unfortunately, all measurements of these emissions to date have involved sampling procedures that allowed the flue gas to age prior to N_2O analysis. In this article the authors report a computer modeling study of the chemical reactions which occur during the aging of flue gas samples. These reactions can produce N_2O in the amounts observed and there is no need to assume that N_2O was initially present.

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Refer also to citation(s) 52148, 52854, 52855, 52951, 52952, 52953

52156 (CESI–85-44) **Fire propagation along cable bundles: influencing factors, testing methods and relevant state-of-the-art standards.** Farneti, F.; Gasparini, G.; Ostano, P. Ente Nazionale per l'Energia Elettrica, Milan (Italy); Shinetsu Chemical Industry Co. Ltd., Takefu, Fukui (Japan). Nov 1985. 20p. (In Italian). (CONF-8511350–1: Workshop of the Italian Electrotechnical Association: fire and electric plants, Milan (Italy), 13-14 Nov 1985). Order Number DE89793138. Available from NTIS (US Sales Only), PC A03.

This paper deals with the main causes of fire propagation along cable bundles. Influencing factors, testing methods and relevant state-of-the-art standards are examined. Moreover, in support of these considerations, lab tests results are reported.

52157 (DOE/BP/16380–3) **Garrison-Taft 500 kV transmission project: Hunter survey, Phase 2: Final report.** Allen, S. USDOE Bonneville Power Administration, Portland, OR (USA); Montana Dept. of Natural Resources and Conservation, Helena, MT (USA); Allen (Stewart), Moscow, ID (USA). Jul 1989. 58p. Sponsored by U.S. DOE Bonneville Power Administration; U.S. DOE Management & Administration. DOE Contract AI79-84BP16380. FS-SAJM-115. Order Number DE89017659. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This report presents the results of the Phase 2 survey of hunters conducted to assess the impacts of Bonneville Power Administration's 500-kV transmission line on elk hunting opportunities in western Montana. The survey is the second in a series of three; a baseline study was conducted in 1983 before the line was constructed and a mail survey will be conducted in 1987. The three surveys form the social component of the Elk Monitoring and Mitigation Project being conducted by several state and federal agencies. A report prepared by the Montana Department of Fish, Wildlife and Parks contains background information on the transmission line and entire monitoring effort, a description of the two primary study areas, and progress on the biological component of the study. 2 refs., 4 tabs.

52158 (DOE/BP/16380–4) **Garrison-Taft 500 kV transmission project: Hunter survey, Phase 3: Final report.** Allen, S. USDOE Bonneville Power Administration, Portland, OR (USA); Montana Dept. of Natural Resources and Conservation, Helena, MT (USA); Allen (Stewart), Moscow, ID (USA). Jul 1989. 58p. Sponsored by U.S. DOE Bonneville Power Administration; U.S. DOE Management & Administration. DOE Contract AI79-84BP16380. FS-SAJM-115. Order Number DE89017660. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This report presents the results of the Phase 3 survey of hunters conducted to assess the impacts of Bonneville Power Administration's 500-kV transmission line on elk hunting opportunities in western Montana. This survey is the final in a series of three (Allen, 1983; 1988). These three surveys are the social component of the Elk Monitoring and Mitigation Project being conducted by several state and federal agencies. A report prepared by the Montana Department of Fish, Wildlife and Parks contains a description of the entire monitoring effort, a description of the two study areas, and progress on the biological component of the study (Canfield, 1988). The primary concern is that the line and associated access roads could decrease hunters' perceptions of the quality of the setting, potentially leading to less satisfaction. Hunters could continue to hunt in the areas but with less enjoyment, they could discontinue hunting in the area, or they could continue to use the area, but differently than before. The study also was designed to identify positive effects of the line. The Phase 3 hunter survey asked a sample of hunters interviewed at check stations during Phase 2 about their use of the DeBorgia (western) study area and the Harvey Creek-Eightmile (eastern) study area during the Fall, 1987 hunting season. Before presenting the methods and results, it may be helpful to summarize the findings from the Phase 1 and 2 hunter surveys, to provide a context for interpreting Phase 3 data. 5 refs., 11 tabs.

52159 (IEIE–8801, pp. 127-130) **Outlook of electric power transmission technology.** Sekine, Yasutsugu (Univ. of Tokyo (Japan)). Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). In *1988 joint convention record of institutes of electrical and information engineers, Japan (part 1).* Available from NTIS (US Sales Only), PC A09/MF A01.

This paper discusses the outlook of electric power systems and electric power transmission technology in the 21st century from the following two viewpoints: (A) How electric power transmission technology is positioned in electric power technology and what degree of importance it has; (B) what techniques will be the most important in the field of electric power transmission technology. For investigation, attention was focused on demand which is the most influential factor in developing and implementing new technology. The following three cases were assumed, and problems were studied for each case. (1) Case 1 – demand will stay at the present level; (2) case 2 – demand will be saturated; (3) case 3 – demand will be distributed to local districts. 6 figures.

52160 (IEIE–8801, pp. 131-134) **UHV power transmission at present and in the future.** Hayashi, Takashi (Tokyo Electric Power Co. Inc. (Japan)). Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). In *1988 joint convention record of institutes of electrical and information engineers, Japan (part 1).* Available from NTIS (US Sales Only), PC A09/MF A01.

This paper outlines ultra-high-voltage (UHV) power transmission – transmission of 1,000,000 V – technology which allows a huge amount of electricity to be transmitted over a long distance efficiently and discusses various problems involved in this technology. Subjects covered are as follows: (1) The present UHV power transmission plans in and outside Japan are reviewed. (2) Elements of UHV power transmission technology – power system technology, insulation technology, protection from environmental pollution, tower design, and substation design – are outlined. (3) The future outlook of UHV power transmission technology is discussed. 3 figures, 5 tables.

52161 (IEIE–8801, pp. 135-138) **Substation technology at present and in the future.** Yoshioka, Yoshio (Hitachi, Ltd., Tokyo (Japan)). Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). In *1988 joint convention record of institutes of electrical and information engineers, Japan (part 1).* Available from NTIS (US Sales Only), PC A09/MF A01.

Demand for substation facilities and technology which take a pivotal role in power system is considerably changing from the days of rapid economic growth when high-voltage, large-capacity substation facilities were demanded to fulfill increasing requests for electric power to the present time when reliable power supply is demanded. Noticing this change, this paper discusses substation technology at present and in the future. Subjects covered are as follows: (1) Substation facilities and control and protective equipment at present – the trends in the technical development of substation facilities are outlined; also, the development at present of transformers, breakers, gas-insulated switches, and control and protective equipment, and power system stabilizers is discussed. (2) Outlook of substation technology – discussion is focused on transformers, gas-insulated switches, control and protective equipment, and functional substations. 15 references, 7 figures.

52162 (IEIE–8801, pp. 139-142) **Feasibility of superconducting and other new technology.** Sugimoto, Osamu (Kansai Electric

Power Co. Inc., Osaka (Japan)). Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). In *1988 joint convention record of institutes of electrical and information engineers, Japan (part 1).* Available from NTIS (US Sales Only), PC A09/MF A01.

This paper discusses the trends in new technology centering on superconducting technology and the influence of such new technology on the distribution of electric power. The discussion is divided into three parts: (1) The characteristics of electric power and its distribution systems are compared with those of general physical materials distribution and are summarized. (2) The utilization of electric energy and the influence of superconducting on it are reviewed. (3) The application of superconducting and other new technology to electric power transmission is outlined. The discussion here covers superconducting cables (AC and DC), superconducting transformers (DC), SEMS and new cells, current limiters (AC and DC), and superconducting power electronics devices. 3 tables.

21 NUCLEAR POWER PLANTS

Refer also to citation(s) 51643, 52323

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

Refer also to citation(s) 51769, 52230, 52279, 52301, 52329, 52331, 52332, 52333, 52334, 52335, 52336, 52337, 52620, 52889

52163 (JAERI-M–89-055) **Use of rod internal pressure sensor and cladding extensometer as failure detection monitors during reactivity initiated accident conditions.** Yanagisawa, Kazuaki; Yamazaki, Satoshi; Aida, Syuuzou. Japan Atomic Energy Research Inst., Tokyo (Japan). May 1989. 22p. (In Japanese). Order Number DE90710031. Available from NTIS (US Sales Only), PC A03/MF A01.

A sealing component of rod internal pressure detector which has been used in past NSRR experiments was modified. Without degrading a pressure leak rate, detector assembling time was saved up to one twenty-forth of the previous. To check an in-core performance, the detector was provided for experiments carried out under reactivity initiated accident (RIA) conditions. It is well known that the defected fuel rod will accompany not only a rapid decrease of rod internal pressure but also a sudden shrinkage of accumulated axial elongations (latter is known to ONCHI effect). During experiments, both phenomena could be detected by the provided pressure detector and by the provided cladding extensometer. Consequently, it was demonstrated that the modified pressure sensor was applicable as the failure monitor of fuel rod during RIA conditions. (author).

52164 (NUREG–0975-Vol.7, pp. 1-60) **Heavy-Section Steel Technology Program.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering. May 1989. In *Compilation of contract research for the Materials Engineering Branch, Division of Engineers. Annual report for FY 1988.* Order Number DE89011888. Available from NTIS, PC A16/MF A01 - I.

The Heavy-Section Steel Technology (HSST) Program is conducted for the Nuclear Regulatory Commission (NRC). The studies relate to all areas of the technology of materials fabricated into thick-section primary-coolant containment systems of light-water-cooled nuclear power reactors. The focus is on the behavior and structural integrity of steel pressure vessels containing crack-like flaws. The program is organized into 12 tasks: (1) program management, (2) fracture methodology and analysis, (3) material characterization and properties, (4) special technical assistance, (5) crack-arrest technology, (6) irradiation effects studies, (7) cladding evaluations, (8) intermediate vessel tests and analysis, (9) thermal-shock technology, (10) pressurized-thermal-shock technology (11) Pressure Vessel Research Users' Facility (PVRUF), and (12) shipping cask material evaluations.

52165 **Modeling and analysis of PCI in locally corroded BWR fuel.** Rashid, Y.R.; Alapour, A.; Folk, K.S.; Lin, C. *Transactions of the American Nuclear Society (USA),* 56: 89-90 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Localized corrosion in some boiling water reactor (BWR) plants is suspected of being a contributor to pellet/clad interaction (PCI) failures at high burnup, where localized PCI, coinciding with corrosion pits, could lead to cladding failure at moderate power levels. The effects of PCI on cladding failure in heavily corroded fuel rods are further enhanced by cladding overheating due to degraded heat transfer. Furthermore, steam blanketing in narrow gaps formed by oxide layer separation can cause local overheating in excess of 250°C. An analytical study of this problem is made tractable through the use of the fuel behavior code FREY. This study is used to examine the validity of the FREY code for this type of application and to provide an understanding of the underlying principles. The analysis is extended to evaluate corrosion effects as a function of defect size, cladding temperature, and power ramp rate.

52166 **Minimal cost reload method for boiling water reactors using the HUDDLE code.** Kim, H.C.; Hsiao, M.Y.; Levine, S.H. *Transactions of the American Nuclear Society (USA),* 56: 93-94 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Optimal fuel management achieves minimal energy cost. Previous publications describe methods for minimizing the ^{235}U as one objective function in each cycle or maximizing burnup or end-of-cycle (EOC) k_{eff}, which leads to the low-leakage cores. However, increasing the burnup of the discharged fuel assemblies as a second objective function will also result in lower energy costs. In this paper, the authors present a method for optimizing multifuel cycles using the two objective functions consecutively to minimize the fuel costs for boiling water reactors (BWRs).

52167 **An expert system to estimate SNM production at LWR systems.** Sandquist, G.M.; Allison, J.L.; Rogers, V.C. *Transactions of the American Nuclear Society (USA),* 56: 87-88 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

An artificial intelligence expert system, analysis of proliferation by expert system (APES), has been developed and tested to permit a nonexpert to quickly evaluate the capabilities and capacities of a reactor and reprocessing system for producing and separating plutonium [special nuclear material (SNM)] even when system information may be limited and uncertain. The present analysis domain of APES is directed at light water reactors and Purex reprocessing, but extension of the domain is planned.

52168 **Benefits of routinely performing ultrasonic inspections for failures in irradiated fuel.** Snyder, B.J. *Transactions of the American Nuclear Society (USA),* 56: 100-102 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Irradiated LWR fuel has been inspected with the Brown Boveri ultrasonic system, the failed fuel rod detection system, in 57 separate campaigns worldwide. Over 800 000 individual fuel rods have been inspected for through-wall defects, with ≈75% of these inspections performed in the United States and the balance in Europe and Asia. As a result of these inspections, Brown Boveri has developed an extensive data base on fuel failure rates. In addition, US utilities have provided information on primary coolant radioactivity levels, in response to a Brown Boveri questionnaire. The purpose of this paper is to show benefits of inspecting fuel based on the results of analyses of this data base and changes in coolant activity levels due to identification and removal of failed fuel.

52169 **Canisters for PCDP [Prototypical Consolidation Demonstration Program] consolidated fuel.** Hart, S.R.; Williams, K.L. *Transactions of the American Nuclear Society (USA),* 56: 105 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Through its Prototypical Consolidation Demonstration Program (PCDP), the US Department of Energy (DOE) is developing fuel consolidation equipment to reduce the storage volume required in national storage facilities, i.e., the geologic repositories. The equipment will be tested at the Idaho National Engineering Laboratory

(INEL) during 1990 and 1991, using hot spent-fuel assemblies obtained form utilities. The resulting consolidated fuel canisters will subsequently be stored at INEL in large dry-storage casks. This paper briefly discusses the national canister development efforts and the canisters that have been used for US consolidation efforts to date. It then focuses on the consolidated fuel canisters under development for the PCDP.

52170 **Benefits of barrier fuel on fuel cycle economics.** Crowther, R.L.; Kunz, C.L. *Transactions of the American Nuclear Society (USA),* 56: 117-118 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Barrier fuel rod cladding was developed to eliminate fuel rod failures from pellet/cladding stress/corrosion interaction and to eliminate the associated need to restrict the rate at which fuel rod power can be increased. The performance of barrier cladding has been demonstrated through extensive testing and through production application to many boiling water reactors (BWRs). Power reactor data have shown that barrier fuel rod cladding has a significant beneficial effect on plant capacity factor and plant operating costs and significantly increases fuel reliability. Independent of the fuel reliability benefit, it is less obvious that barrier fuel has a beneficial effect of fuel cycle costs, since barrier cladding is more costly to fabricate. Evaluations, measurements, and development activities, however, have shown that the fuel cycle cost benefits of barrier fuel are large. This paper is a summary of development activities that have shown that application of barrier fuel significantly reduces BWR fuel cycle costs.

52171 **Implementation of an advanced BWR design.** Sofer, G.A.; Collingham, R.E.; Walters, K.V. *Transactions of the American Nuclear Society (USA),* 56: 119-121 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Over the past several years, Advanced Nuclear Fuels (ANF) Corporation has devoted substantial development and design effort to the implementation of an advanced 9 x 9 array fuel design for boiling water reactors (BWRs). This advanced 9 x 9 design, designated AND-95, which has increased interior moderation through the use of five water rods, is capable of higher burnup than 8 x 8 fuel because of its lower linear heat generation rate (LHGR) and promises to allow unrestricted power maneuvering and load follow without the extra cost of introducing a zirconium liner. The first fuel reload incorporating this design is under fabrication and is expected to be in operation in a 47 kW/l power density BWR during the summer of 1988. Key design features of this fuel are given and are compared to a late-model 8 x 8 fuel. The paper discusses increased neutron economy, improved burnup capability, improved emergency core cooling system, improved critical heat flux capability, load-follow capability, and fuel cycle costs.

52172 **TEM [transmission electron microscopy], APFIM [atom-probe field ion microscopy], and SANS [small-angle neutron scattering] examination of aged duplex stainless steel components from some decommissioned reactors.** Chung, H.M. (Argonne National Lab., IL (USA)); Chopra, O.K. *Transactions of the American Nuclear Society (USA),* 56: 249-252 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Cast stainless steels, composed of duplex phases of austenite and ferrite, are used extensively in nuclear reactors because of their superior strength, weldability, resistance to stress corrosion cracking, and soundness of casting. For example, cast stainless steels are used for primary coiling pipes of pressurized water reactors (PWRs), and valves and pump casings of PWRs and boiling water reactors (BWRs), the structural integrity of which is vital for safe operation of the reactors. In the present investigation, microstructural characteristics of several long-term-aged field components from two decommissioned reactors have been examined by transmission electron microscopy (TEM), atom-probe field ion microscopy (APFIM), and small-angle neutron scattering (SANS) techniques to establish the embrittlement mechanisms for the reactor-aged material. The results have then been compared to those of the laboratory-aged specimens obtained for the temperature range between 300 and 450°C. The chemical compositions and ferrite contents of the reactor components are listed. KRB BWR (located in Gundremmingen, Federal Republic of Germany) had been in service for ≈12 yr, and the Shippingport PWR (near Pittsburgh, Pennsylvania) had operated for ≈22 yr.

52173 **Demonstration of a prefilming technique for primary piping in a Japanese BWR.** Honda, Takashi; Ohsumi, Katsumi; Aizawa, Motohiro; Takagi, Kiichiro; Amano, Osamu; Yamashita, Kazuhiko. *Transactions of the American Nuclear Society (USA),* 56: 253 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Radioactive corrosion products such as ^{60}Co deposit on out-of-core components, which are primarily made of stainless steel, in boiling water reactor (BWR) plants. Several studies have indicated that the deposition rate is controlled mainly by the growth rate of oxide films formed on the steel through corrosion. Therefore, it is reasonable to assume that the suppression of corrosion should prevent deposition. This idea has been substantiated by using a prefilming technique. This technique involves forming a corrosion-resistant oxide layer on steel before exposure to normal BWR conditions. A prefilming method designated as the alkaline process was successfully applied to a new Japanese BWR plant during the nuclear heatup phase in plant preoperation. Corrosion-resistant oxide films could be formed on stainless steel within a short period through the treatment. The results of exposure tests carried out at the same time indicated that an ≈30% reduction was obtained by prefilming for the deposition of radionuclides such as ^{60}Co, compared with ordinary operation procedures.

52174 **Modeling of GE generations 2 and 3 separators using the RETRAN-02/MOD3 separator model.** Wang, Songfeng; Tang, Janru; Hung, Huanjen. *Transactions of the American Nuclear Society (USA),* 56: 288-289 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The basic characteristics of steam separators can be described by two parameters, carryover and carryunder. However, in most of the nuclear power plant analyses using large computer codes, such as RETRAN, the separator has been simulated by a bubble rise model (BRM), a complete separation two-phase model. Such a modeling technique may cause sizable deviation in calculational results when the above two parameters have significant effects on transient responses. The purpose of this study was to develop a modeling procedure for separators with General Electric (GE) generation 2 and 3 designs. In addition, techniques for preparing key input parameters for the analysis model were also developed. The basic performance curves in terms of normalized carryover and carryunder versus normalized inlet quality and level for generation 2 and 3 separators, which have been verified under separate study, were adopted in the preset procedure development. The procedure was then followed to establish the plant-specific BWR/4 model for Chinshan nuclear power plant. Good agreements were observed between code predictions and the 100% power load rejection test as described in a separate paper.

52175 **Criticality experiments with units of LWR-type fuel rods submerged in water and separated by neutron flux traps.** Bierman, S.R. *Transactions of the American Nuclear Society (USA),* 56: 316-318 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

A series of criticality experiments to provide benchmark-type data on neutron flux traps has been completed at the US Department of Energy Hanford Critical Mass Laboratory, operated by the Pacific Northwest Laboratories of Battelle Memorial Institute. The experiments were funded by the Sandia National Laboratory, and are designed to simulate transport environments and high-density fuel storage facilities. The experimental assemblies consisted of 2 x 2 arrays of 4.31 wt% ^{235}U-enriched UO_2 fuel rods arranged in water on a 1.891-cm^2 center-to-center spacing. This lattice spacing results in a moderator-to-fuel volume ratio of 1.6, which approximates that found typically in boiling water reactors and in pressurized water reactors. Each assembly consisted of four, near equally sized units of fuel rods separated by a neutron flux trap and varying amounts of moderator.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

Refer also to citation(s) 51942, 52163, 52164, 52167, 52168, 52169, 52172, 52175, 52211, 52214, 52215, 52216, 52217, 52218, 52219, 52230, 52279, 52296, 52298, 52299, 52300, 52326, 52329, 52331, 52332, 52333, 52336, 52337, 52338, 52343, 52350, 52351, 52352, 52353, 52354, 52355, 52358, 52359, 52885, 52889, 53986

52176 (DP-MS–89-4-Rev.1) **Application of Lotus 1-2-3 to heat transfer analysis: Revision 1.** Bornt, F.W. Westinghouse Savannah River Co., Aiken, SC (USA). [1989]. 24p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-891192–14: Annual Westinghouse computer symposium, Pittsburgh, PA (USA), 6-7 Nov 1989). Order Number DE89017840. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In order to perform heat transfer analyses that are a bit involved for hand calculations, but are not quite "large" enough to justify the use of a special purpose heat transfer computer code, this paper proposes the use of Lotus 1-2-3 for several of these "in between" problems: Temperature Rise Along a PWR Coolant Channel; Auxiliary Feedwater Pump Room; and Superheater Enclosure Insulation Thickness. 8 refs., 10 figs.

52177 (JAERI-M–89-048) **Development of degraded core coolability analysis program.** Abe, Yutaka; Maruyama, Yu; Soda, Kunihisa; Mino, Yoshitaka. Japan Atomic Energy Research Inst., Tokyo (Japan). May 1989. 65p. (In Japanese). Order Number DE90709982. Available from NTIS (US Sales Only), PC A04/MF A01.

In case of a severe accident of a light water reactor caused by loss of core cooling capacity, as was observed in the TMI-2 accident, a debris bed consisting of the degraded core materials may be formed as the result of the interaction between the melting core materials and coolant water. Since the debris bed continues to release decay heat, the debris bed would melt again if the debris bed would not be cooled. Therefore, it is quite important to estimate the coolability of the debris bed in order to evaluate accident progression and terminate the accident within the reactor pressure vessel. In this work, the degraded core coolability analysis program to predict dryout heat flux of the debris bed and the database containing the previous experimental results were developed. In addition, the analysis program was verified by comparing the analysis results with the experimantals. It is expected that the analysis program would offer valuable information for the accident progression analysis and the accidnet management straregies togather with database. (author).

52178 Engineering application of loading pattern optimization program to reload design. Chung, D.Y.; Pulver, E.F.; Yeh, R.Y.; Bahr, K.E.; Erwin, R.D. *Transactions of the American Nuclear Society (USA),* 56: 98-100 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The conventional forward diffusion approach currently used in the design process for developing and optimizing loading patterns (LPs) for standard reloads is illustrated. In cases where new design features have been introduced (such as extreme low-leakage patterns, extended cycles of greater than 18 months, reduced-length burnable absorbers, and axial blankets), it has become increasingly difficult with the conventional approach to find candidate LPs that meet all the design constraints, such as peaking factors and moderator temperature coefficient limits. An automated LP optimization computer program (LPOP), recently developed at Westinghouse, has been used in several applications for determining reload candidate LPs with new design features. The innovative LPOP methodology uses a backward/forward approach in combination with an expert rule-based matching routine that is able to generate a large number of LPs.

52179 The cost of operating with failed fuel at Virginia power. Ford, C.A. *Transactions of the American Nuclear Society (USA),* 56: 95-97 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Virginia Power has completed a study of the costs incurred due to fuel failures in its pressurized water reactors. This study was prompted by histories of high primary coolant activity and subsequent fuel inspections at the North Anna and Surry power stations. The study included an evaluation of the total costs of fuel failures as well as an evaluation of the economics of postirradiation fuel inspections. The major costs of fuel failures included personnel radiation exposure, permanently discharged failed fuel, radwaste generation, increased labor requirements, containment entry delays due to airborne radioactivity, and ramp rate restrictions. Although fuel failures affect a utility in several other areas, the items evaluated in the study were thought to be the most significant of the costs. The study indicated that performing a postirradiation failed fuel examination can be economically justified at tramp-corrected ^{131}I levels of > 0.015 μCi/g. The savings to the utility can be on the order of several million dollars. Additionally, the cost penalty of performing a fuel inspection at lower iodine levels is generally in the range of $200,000. This economic penalty is expected to be outweighed by the intangible benefits of operating with a defect-free core.

52180 Spent fuel rod consolidation at Prairie Island. Kapitz, J.; McCarten, L. *Transactions of the American Nuclear Society (USA),* 56: 103 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Northern States Power (NSP) has recently completed a demonstration of spent fuel rod consolidation at its Prairie Island Nuclear Generating Plant (PI). This demonstration involved dismantling 36 fuel assemblies and placing their fuel rods into 18 canisters, each one the size of a single fuel assembly. With the current fuel management strategy at PI, the existing storage space will be exhausted by 1994 to 1995. Because of the timetable for the federal waste disposal program, PI will need a minimum of 5 yr of additional interim spent-fuel storage capacity. Several technologies available to provide this interim capacity are being evaluated. As part of this evaluation, it was decided to perform a demonstration of the Westinghouse consolidation process. The scope of work performed during the consolidation demonstration involved dismantling the fuel assemblies and placing the rods from two assemblies into a storage canister the size of one fuel assembly. The empty cages were placed back into the storage racks for later processing. The top and bottom nozzles were placed in stacks of eight or ten and also stored in the spent-fuel racks for future disposal.

52181 An approach to fuel consolidation-an update. Matheson, J.E.; Maillet, J. *Transactions of the American Nuclear Society (USA),* 56: 103-105 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Since the spent-fuel pools at nuclear reactors were generally not designed for life-of-plant storage capacity, they are rapidly filling up. The U.S. Department of Energy, in accordance with the Nuclear Waste Policy Act of 1982, plans to alleviate this problem in 1998. Meanwhile, solutions to the storage problem are actively being sought. One of these, fuel consolidation, has already been demonstrated to be practical for pressurized water reactor fuel. The current cost of fuel consolidation appears to be very competitive with alternative technologies, such as on-site dry storage, and should decrease in time. However, to be an attractive solution, consolidation must also be clean, reliable, and effective. Based on previous experience working in spent-fuel pools, a system was chosen that would consist of simple, proven mechanisms, arranged to provide sufficient speed to achieve the cost goals. The challenge to the designers was to devise a simple machine that could get >500 spent-fuel rods into a close-packed array, compact the leftover hardware, and leave behind clean water and at least 40% more space. The resulting system is simple by design. Thus, its reliability should be high and its maintenance needs will be minima. The process rate is enhanced by providing duplicated devices where practical. Direct canister loading, reusing end fittings for canister handling, and on-line NFBC shearing are the salient features of the machine that differentiate it from others that have been demonstrated to date.

52182 Options and trade-offs for in-core fuel management. Spetz, S.W. *Transactions of the American Nuclear Society (USA),* 56: 115-116 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The PWR fuel manager is faced with a number of options for improving in-core fuel management and associated fuel costs.

Selecting these options involves both economic and physical trade-offs, the latter resulting from increased uranium enrichments and the requirements for thermal and loss-of-coolant-accident (LOCA) margins. In the future, when power reserves are diminished, these options must also compete for margin against proposed plant power upgrades. This paper provides an assessment of the benefits, trade-offs, and claims against margins for five major options: extended burnup, axial blankets, very low leakage shuffle schemes, burnable poisons, and scheduled coastdowns. It provides estimated cost savings as well as impacts on departure from nucleate boiling and (LOCA) margins.

52183 Extended cycle length economics. Anderson, C.K. *Transactions of the American Nuclear Society (USA),* 56: 116-117 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Utility experience in the Untied States has shown that extending fuel cycle length from 12 to 18 months or more can provide a significant reduction in total power generation cost as a result of higher plant availability and reduced replacement power cost. An essential factor in the economic implementation of longer cycles is the use of advanced fuel design features, such a s high burnup, optimum burnable poisons, and low-leakage fuel-loading patterns, which compensate for the fuel cycle cost penalty that would otherwise be associated with longer cycles. Use of such features combined with advanced reactor engineering methods has enabled a smooth transition to extended cycles for many Combustion Engineering (C-E) customers. Cycle 8 of Calvert Cliffs unit 2, which began in the spring of 1987, makes the first 24-month cycle in a US pressurized water reactor. Unit 1 is scheduled to begin 24-month cycle operation in the spring of 1988. The two Calvert Cliffs units will refuel during the spring of alternated years, and the low-cost replacement power available to BG & E during the spring season should produce savings of 1 to 2% of annual energy costs compared to present operations with 18-month cycles.

52184 Westinghouse VANTAGE+ fuel assembly to meet future PWR operating requirements. Doshi, P.K.; Chapin, D.L.; Scherpereel, L.R. *Transactions of the American Nuclear Society (USA),* 56: 118-119 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Many utilities operating pressurized water reactors (PWRs) are implementing longer reload cycles. Westinghouse is addressing this trend with fuel products that increase fuel utilization through higher discharge burnups. Higher burnup helps to offset added enriched uranium costs necessary to enable the higher energy output of longer cycles. Current fuel products have burnup capabilities in the area of 40,000 MWd/tonne U or more. There are three main phenomena that must be addressed to achieve even higher burnup levels: accelerated cladding, waterside corrosion, and hydriding; increased fission gas production; and fuel rod growth. Long cycle lengths also require efficient burnable absorbers to control the excess reactivity associated with increased fuel enrichment while maintaining a low residual absorber penalty at the end of cycle. Westinghouse VANTAGE + PWR fuel incorporates features intended to enhance fuel performance at very high burnups, including advances in the three basic elements of the fuel assembly: fuel cladding, fuel rod, and fuel assembly skeleton. ZIRLO ™ cladding, an advanced Zircaloy cladding that contains niobium, offers a significant improvement in corrosion resistance relative to Zircaloy-4. Another important Westinghouse PWR fuel feature that facilitates long cycles is the zirconium diboride integral fuel burnable absorber (ZrB_2IFBA).

52185 Sensitization and SCC [stress corrosion cracking] study on thermally treated Inconel 600. Kai, J-J.; Huang, T.A.; Tsai, C.H. *Transactions of the American Nuclear Society (USA),* 56: 247-249 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Stress corrosion cracking (SCC) was recently discovered to be the major cause of failure in Inconel 600 used in steam generator (SG) tubes of pressurized water reactors (PWRs). The failure of the Three Mile Island SG tubes has been attributed to low-temperature SCC in the sulfur-contaminated environment under cold shutdown conditions. Bandy et al. found that even in the 10^{-6} M $Na_2S_2O_3$ (or $N_2S_4O_6$) environment, the SCC would still be observable. This study investigates the effect of thermal treatment on the sensitization of Inconel 600 and studies the SCC behavior of this alloy in a sulfur-contaminated environment ($S_2O_3^{-2}$) using constant load test. The results of this study can be used to correlate the SCC susceptibility to the degree of sensitization of Inconel 600 by defining a critical chromium concentration under the test conditions.

52186 One-and-a-half-dimensional PWR core model for fuel management applications. Petrovic, B.G.; Levine, S.H. *Transactions of the American Nuclear Society (USA),* 56: 296-298 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Fuel management optimization calculations require a very large number of repetitive calculations of flux/power distribution and corresponding k_{eff}, which consumes the major portion of the computer time. To increase the speed of this calculation and maintain adequate two-dimensional geometry accuracy relative to the usual 1 1/2-energy group coarse spatial mesh calculation, a new approach is presented, based on 1 1/2D geometry. In this model, the diffusion equation is solved in one-dimensional geometry, and the results are unfolded to produce the two-dimensional flux/power map. The two-group energy structure is preserved. Due to the simple linear (and not quadratic) increase in the number of mesh points, the mesh need not be coarse. This summary describes the new model, which is employed in the computer code MCYC1.5D. Initial benchmarking versus the two-dimensional model produced reasonably accurate results at speeds 20 to 50 times faster than the two-dimensional reference spatial code.

2103 Power Reactors, Non-breeding, Graphite Moderated

Refer also to citation(s) 52151, 52295, 52303, 52304, 52305, 52306, 52308, 52310, 52311, 52312, 52313, 52314, 52315, 52316, 52317, 52318, 52319, 52320, 52321, 52328, 52344, 52345, 52347, 52361, 53286, 53432, 53433, 53434, 53435, 53436, 53438, 53439

52187 (CEGB-RD/B–6081/R88) **Radioactive inventory of a Berkeley heat exchanger.** Hancock, R. Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs. Oct 1988. 16p. Order Number DE90606792. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The Central Electricity Generating Board has announced a date for the final shutdown of the first of the Magnox power stations at Berkeley (March 1989), and is in the process of preparing Pre-Decommissioning Safety Reports (PDSR) for the decommissioning of Berkeley and Bradwell. This report supports these PDSR studies and reports work carried out within the Research Division at Berkeley Nuclear Laboratories on the radioactive inventories of the heat exchangers at Berkeley Power Station. At Berkeley, the heat exchangers will be included in stage two decommissioning to which they will contribute the largest mass of contaminated material. The purpose of this report is to bring together all of the available data on the contamination in the heat exchangers at Berkeley Power Station, and to recommend a database from which the options for disposal of the heat exchangers may be formulated. (author).

52188 (CEGB-RD/L–3352/R88) **CERL in-situ probe for boiler ferrule bore mensuration.** Collins, T.M.; Beck, R.F. Central Electricity Research Labs., Leatherhead (UK). Oct 1988. 16p. Order Number DE90606793. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Mensuration of the bores of boiler feed control ferrules in-situ within the AGR boilers can be done using a Central Electricity Research Laboratories-designed probe and ancillary equipment. From these measurements it is possible to determine the loss coefficients of the ferrules with fair accuracy. These loss coefficients may differ from the intended values because of poor quality control during manufacture or because of erosion and oxide deposition in service. This Report describes the construction and operation of the equipment. (author).

52189 (JAERI-M–89-007) **Research and development of HTGR fuels.** Fukuda, Kousaku; Ogawa, Toru; Kashimura, Satoru and others. Japan Atomic Energy Research Inst., Tokyo (Japan).

Feb 1989. 611p. (In Japanese). Order Number DE90710050. Available from NTIS (US Sales Only), PC A99/MF A01.

This report describes the results summarized from the research except the fuel inspection and the advanced fuel development, which have been carried out for 15 years at Fuel Irradiation and Analysis Laboratory of JAERI. Concerning fuel production, outline of production methods, and production achievement for OGL-1 and capsule irradiation experiments are included. Irradiation experiments involve the methods of irradiation and the irradiation conditions. Concerning the fission product behavior, fission gas release which was obtained in the OGL-1 and gas swept capsule experiments, tritium behavior, metallic fission product behavior, and diffusion coefficients are described. Performance of coated particles touches upon failure fraction of SiC coating layer, anisotropy factor of PyC, amoeba effects and so on, while fuel performance, mechanical strength, irradiation induced dimensional change, thermal conductivity and specific heat are described as the properties of the fuel compact. Irradiation behavior of a fuel rod and a fuel block such as bowing is also described. And finally fuel behavior under accident conditions including fission product release is mentioned. (author).

52190 (Juel-Conf–64) **Working report of the Institute of Reactor Components at the KFA Juelich. Scientific lectures of the commemorative colloquium held on September 2, 1987 at the KFA Juelich.** Scholz, F. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente. Sep 1988. 105p. (In German). Order Number DE90711187. Available from NTIS (US Sales Only), PC A06/MF A01.

A scientific colloquium was held on 2nd September 1987 to mark the 60th birthday of Prof. Dr. C.B. von der Decken and the 30th anniversary of the Institute for Reactor Components (IRB) of the Juelich Nuclear Research Center (KFA Juelich). On this occasion, a selection of studies carried out at the Institute was presented in 8 lectures. This was followed by an inspection of the Institute's experimental facilities during which on-the-spot information was supplied on other studies by the Institute. A summary of the enlarged versions of the lectures is presented below, as a response to a wish that has been expressed many times. Summaries were obtainable at the colloquium. (orig.).

52191 (Juel-Conf–64, pp. 54-64) **Special problems of heat- and flow transfer in heat exchangers of HTGR type reactors.** Groehn, H.G. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente. Sep 1988. (In German). In *Working report of the Institute of Reactor Components at the KFA Juelich. Scientific lectures of the commemorative colloquium held on September 2, 1987 at the KFA Juelich.* Order Number DE90711187. Available from NTIS (US Sales Only), PC A06/MF A01.

A heat pipe with an oblique flow is one in which the angle between the initial direction of flow and the pipe axis is larger than 0^0 and smaller than 90^0. A brief outline is given of two examples of an oblique flow in heat exchangers. In one of the apparatuses, the main-flow direction of the fluid bypassing the pipes runs parallel to the pipe axle; the angle of attack therefore is 0^0. In the inflow and outflow areas of the heat exchanger the pipes admit a cross flow and/or an oblique flow. Under conventional operating conditions, this area, which is geometrically small by comparison with the total length of the apparatus, is of secondary importance; as regards heat exchangers with a high thermal stress, accurate knowledge of temperature and velocity distributions in the inflow and outflow areas is decisive for the operational life of the components. In the other heat exchanger, the pipes admit an oblique flow through their entire length. The chain-dotted lines symbolize pipe cylinders on which the pipes are helically coiled around a central pipe. A special feature of the pipe arrangement shown - this should be noted - lies in the fact that the pipes are coiled in opposite directions on adjacent pipe cylinders. As a result, intersecting pipe coils emerge with special fluidic characteristics. These features, which result from the transition of the inclination of all the pipes in the same direction to their crosswise inclination, need to be described more profoundly here. (orig./GL).

52192 (Juel-Conf–64, pp. 65-71) **Vibration engineering design rules for heat exchangers taking into account operational safety and environmental load.** Heinecke, E. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente. Sep 1988. (In German). In *Working report of the Institute of Reactor Components at the KFA Juelich. Scientific lectures of the commemorative colloquium held on September 2, 1987 at the KFA Juelich.* Order Number DE90711187. Available from NTIS (US Sales Only), PC A06/MF A01.

A description is given of the problem of acoustic and mechanical resonance phenomena and their consequences for the operational safety of shell-and-tube heat exchangers conveying fluids in cross flow, as are used in power and process-engineering plants. Information concerning model laws and experimental data is supplied. The influence of the various parameters to be considered during the laying out of large-scale apparatuses is discussed. A description is given of more extensively performed experiments aimed at grasping those parameters which have remained unstudied so far. The results of the investigation have been successfully applied in large-scale plants with the aim of preventing or tealing expensive damage. (orig.).

52193 (Juel-Conf–64, pp. 72-87) **Laboratory- and reactor tests on deposition of fission products in an HTR primary coolant circuit.** Biedermann, P.; Sackmann, B. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente. Sep 1988. (In German). In *Working report of the Institute of Reactor Components at the KFA Juelich. Scientific lectures of the commemorative colloquium held on September 2, 1987 at the KFA Juelich.* Order Number DE90711187. Available from NTIS (US Sales Only), PC A06/MF A01.

For licensing procedures knowledge on the behaviour of these fission and activation products is necessary with regard to normal operation (maintenance, inspection, repair) and incidents (for a realistic evaluation of the effects of the dose rate on the environment resulting from the radioactivity release to be expected). The aim of the studies by the Institute for Reactor Components (IRB) on these projects is to describe the transport, deposition, interaction and release processes by physical models and to set up a data base for nuclide and material-specific model parameters. Theoretical fundamentals and theoretical evaluations are dealt with by the Working Group 'Theory', whereas the preparation of the accompanying experiments, the management of those during the test procedure as well as the reinvestigations are mainly carried out by the 'Department for Reactor Technology' of the Institute. (orig./GL).

52194 (Juel-Conf–64, pp. 88-100) **Safety aspects on HTR incidents.** Barthels, H.; Iniotakis, N. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente. Sep 1988. (In German). In *Working report of the Institute of Reactor Components at the KFA Juelich. Scientific lectures of the commemorative colloquium held on September 2, 1987 at the KFA Juelich.* Order Number DE90711187. Available from NTIS (US Sales Only), PC A06/MF A01.

For the extent of the potential damage of a hypothetical core heat-up accident in a HTR-500-reactor, the interaction of the Cs with the graphite of the top reflector is of great importance. With the help of a large model and calculation program 'PATRAS-CORE', which describes the fission product transport through the cooling gas and the interaction with the graphite structures adjacent to the core, it could be shown for the hypothetical accident of uncontrolled core heat-up of a HTR-500 that the top reflector is a very strong barrier for Cs even under extreme accident conditions, i.e. it has a great retention capacity even for extreme durations of accident. The 'PATRAS-CORE' calculation program was experimentally verified in dynamic tests under realistic geometries and accident conditons and thus the great retardation potential of a graphite top reflector was also experimentally proved. Even at the extreme accident temperatures of the graphite reflector of more than 1.000^0C and an extremely long duration of accident of 1.000 h, the potential of the retention factor of the top reflector amounts to 10^{13}. (orig./GL).

52195 (SAND–87-0558) **A review of gas-cooled reactor concepts for SDI [Strategic Defense Initiative] applications.** Marshall, A.C. Sandia National Labs., Albuquerque, NM (USA). Aug 1989. 150p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC04-76DP00789. Order Number DE89016962. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

We have completed a review of multimegawatt gas-cooled reactor concepts proposed for SDI applications. Our study concluded that the principal reason for considering gas-cooled reactors for burst-mode operation was the potential for significant system mass savings over closed-cycle systems if open-cycle gas-cooled operation (effluent exhausted to space) is acceptable. The principal reason for considering gas-cooled reactors for steady-state operation is that they may represent a lower technology risk than other approaches. In the review, nine gas-cooled reactor concepts were compared to identify the most promising. For burst-mode operation, the NERVA (Nuclear Engine for Rocket Vehicle Application) derivative reactor concept emerged as a strong first choice since its performance exceeds the anticipated operational requirements and the technology has been demonstrated and is retrievable. Although the NERVA derivative concepts were determined to be the lead candidates for the Multimegawatt Steady-State (MMWSS) mode as well, their lead over the other candidates is not as great as for the burst mode. 90 refs., 2 figs., 10 tabs.

52196 **Designing a reactor for the next generation.** Neylan, A. (General Atomics, San Diego, CA (US)); Dilling, D.; Ng, R. vp of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y American Society of Mechanical Engineers, New York, NY (1988). (CONF-880702–: 23. intersociety energy conversion engineering conference, Denver, CO (USA), 31 Jul - 5 aug 1988).

Technical Paper 889152.

The Modular High-Temperature Gas-Cooled Reactor (MHTGR) is an advanced reactor concept being developed under a cooperative program involving the U.S. Government, the utilities and the nuclear industry. The design utilizes basic High-Temperature Gas-Cooled Reactor (HTGR) features of ceramic fuel, helium coolant, and a graphite moderator. The specific size and configuration is selected to utilize the inherent materials characteristics associated with these standard features to develop a passively safe design which provides a higher margin of safety and investment protection than current generation reactors. The MHTGR which is now into the preliminary design phase meets regulatory and new, more challenging user requirements. This paper outlines the requirements, describes the design and the current status, shows how the design meets the requirements, and looks at potential future deployment from the vendor's perspective.

52197 **Economic characteristics of a smaller, simpler reactor.** LaBar, M. (Gas-Cooled Reactor Associates (US)); Bowers, H. vp of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y American Society of Mechanical Engineers, New York, NY (1988). (CONF-880702–: 23. intersociety energy conversion engineering conference, Denver, CO (USA), 31 Jul - 5 aug 1988).

Technical Paper 889155.

Reduced load growth and heightened concern with economic risk has led to an expressed utility preference for smaller capacity additions. The Modular High Temperature Reactor (MHTGR) plant has been developed as a small, simple plant that has limited financial risk and is economically competitive with comparatively sized coal plants. Competitive economics is achieved by the simplifications made possible in a small MHTGR, reduction in the quantity of nuclear grade construction and design standardization and certification. Assessments show the MHTGR plant to have an economic advantage over coal plants for plant sizes from 270 MWe to 1080 MWe. Financial risk is limited by small unit sizes and short lead times that allow incremental deployment. Evaluations show the MHTGR incremental deployment capability to reduce negative cash flows by almost a factor of 2 relative to that required by a single large nuclear plant.

52198 **Developing a reactor for today's realities and tomorrow's needs.** Millunzi, A.C. (U.S. Dept. of Energy (US)); Penfield, S.R. Jr. vp of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y American Society of Mechanical Engineers, New York, NY (1988). (CONF-880702–: 23. intersociety energy conversion engineering conference, Denver, CO (USA), 31 Jul - 5 aug 1988).

Technical Paper 889151.

The environment influencing the nuclear power industry in the U.S. has undergone significant changes during the 14 year period since the last active nuclear project was committed. In response to those changes, the HTGR Program conducted a detailed assessment of the underlying bases for nuclear power plant design in 1984. The assessment led to the development of criteria for a next generation reactor that represented a fundamental change in approach relative to then-current technologies. The implementation of these criteria led in turn to the development of the MHTGR, which was selected as the HTGR Program reference concept in September 1985. The selection of the MHTGR and its successful development through the conceptual design phase is, in large part, attributable to a requirements oriented methodology that has been developed and implemented within the HTGR Program.

52199 **Status of international HTGR development.** Homan, F.J. (Oak Ridge National Lab., Oak Ridge, TN (US)); Simon, W.A. vp of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y American Society of Mechanical Engineers, New York, NY (1988). (CONF-880702–: 23. intersociety energy conversion engineering conference, Denver, CO (USA), 31 Jul - 5 aug 1988).

Technical Paper 889156.

Programs for the development of high-temperature gas-cooled reactor (HTGR) technology over the past 30 years in eight countries are briefly described. These programs have included both government sector and industrial sector participation. The programs have produced four electricity-producing prototype/demonstration reactors, two in the United States, and two in the Federal Republic of Germany. Key design parameters for these ractors are compared with the design parameters planned for follow-on commercial-scale HTGRs. The development of HTGR technology has been enhanced by numerous cooperative agreements over the years, involving both government-sponsored national laboratories and industrial participants. Current bilateral cooperative agreements are described. A relatively new component in the HTGR international cooperation is that of multinational industrial alliances focused on supplying commercial-scale HTGR power plants. Current industrial cooperative agreements are briefly discussed.

52200 **Design of major components for the Modular High-Temperature Gas-Cooled Reactor.** McDonald, C.F. (General Atomics, San Diego, CA (US)); Ng, R. vp of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y American Society of Mechanical Engineers, New York, NY (1988). (CONF-880702–: 23. intersociety energy conversion engineering conference, Denver, CO (USA), 31 Jul - 5 aug 1988).

Technical Paper 889238.

The Modular High-Temperature Gas-Cooled Reactor (MHTGR) is an advanced nuclear concept being developed in the USA under a cooperative program involving the U.S. government, the nuclear industry, and utilities. This paper addresses the design of the major components within the nuclear steam supply system (NSSS). A significant technology base exists for the MHTGR plant components and this is emphasized in the paper.

52201 **MHTGR fuel design and quality.** Stansfield, O.M.; Adams, C.C.; DeVelasco, R.I. *Transactions of the American Nuclear Society (USA),* 56: 91-92 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The modular high-temperature gas-cooled reactor (MHTGR) has a top-level goal of safe, economical energy production. Occupational and site boundary irradiation exposure during normal and accident conditions is maintained well below established limits by multiple passive barriers to fission product release. The primary containment for fission products is the coated fuel particle, which consists of a microsphere of ceramic fuel encapsulated by an impervious, refractory coating. More than 10^{10} of these miniature pressure vessels are used in each MHTGR core. The design of the fissile fuel particle is shown. The design of coated particles and the quality achieved have improved significantly over the last two decades in both the United States and the FGR. In the United States the Fort St. Vrain HTGR fuel production set an early standard for quality. This standard was improved by a factor of 20x reduction in defects through the U.S. Department of Energy (DOE)

development program for the earlier 2240-MW(thermal) HTGR and the current MHTGR. In the FRG the quality has improved from the Triso fuel made for the Arbeitsgemeinschaft Versuchsreaktor to current fuel for the gas-cooled reactor designs being developed there. The evolution in fuel quality coupled with the ongoing DOE-sponsored process development and fuel proof test program assures that the MHTGR design goal will be met.

52202 **Materials developments for advanced reactor designs.** Burgsmueller, P.; Charles, H.; Fricker, H. *Transactions of the American Nuclear Society (USA),* 56: 246-247 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Progressing technological demands of advanced reactor development require that the designer have at his disposal quick-responding analytical support as well as immediate access to experimental facilities. The close cooperation between design office, research and development department, and trial manufacturing provides the necessary short iteration loops when developing new methods and products. Over the last two decades, many research programs were directed at solving specific problems with steam generators and heat exchangers, or improving known procedures. From various recent materials, fabrication, and performance tests, a few examples are selected and briefly described. These include bimetallic welds, creep fatigue, surface protection, fabrication tests for large helical bundles, gas mixing, flow-induced vibrations, and sodium technology.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

Refer also to citation(s) 51927

2105 Power Reactors, Breeding

Refer also to citation(s) 51745, 51931, 51944, 52202, 52254, 52265, 52346, 52922

52203 (CONF-8910233–1) **Implementation of a multimodular LMR [liquid metal cooled nuclear reactor] nuclear plant simulation on a parallel computer.** Rovere, L.A.; Brittain, C.R.; Otaduy, P.J. Oak Ridge National Lab., TN (USA). [1989]. 9p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. From South Eastern simulation conference; Pensacola, FL (USA); 16-17 Oct 1989. Order Number DE90000578. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The paper describes the implementation of a simulation code for a multimodular nuclear power plant on a parallel computer. The incentive for this work was based on the need for a fast running code to be used as a testbed to support R&D activities on supervisory control as part of ORNL's Advanced Controls Program. The set of differential equations describing the plant dynamics was partitioned into subsets for parallel integration according to the relative independence of plant component. To this end, functional groups, corresponding to plant subsystems were defined, with each simulated on its own CPU. An outline of this partitioning is presented in this paper. The resulting simulation code was able to run significantly faster than the previously existing code. The partitioning scheme described in this work could be applied in a variety of process simulations involving loosely coupled systems. 5 refs., 7 figs., 1 tab.

52204 (KFK–4596) **Experimental investigation of the effects of a spacer grid with a strong partial blockage on the distributions of the velocity and turbulence in wall subchannels of a rod bundle.** Rehme, K. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter. Jul 1989. 59p. (In German). Order Number DE90711750. Available from NTIS (US Sales Only), PC A04/MF A01.

Measurements of the mean velocity, of the wall shear stresses, and of the turbulence have been performed in two wall subchannels (P/D=1.223; W/D=1.183) of a rod bundle of four parallel rods arranged in a rectangular channel for three axial planes. A spacer grid of the SNR-type was inserted in the rod bundle to fix the rods. In contrast to previous investigations, however, the spacer grid was partially blocked. The measurements were performed at ratios of distance between the spacer grid and the measuring plane and the hydraulic diameter of L/D_h=84.9, 62.8, and 40.4, respectively. The Reynolds number of this investigation was $Re=1.4x10^5$. The distributions of the velocity and turbulence are significantly affected even for L/D_h=84.9 in comparison with the previous results downstream of a spacer grid without a partial blockage. The effects of the blockage increase with decreasing L/D_h. (orig.).

52205 **Progress in the development of metallic fuel in fast reactors.** Seidel, B.R.; Walters, L.C. *Transactions of the American Nuclear Society (USA),* 56: 68 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Renewed interest has developed in metallic fuel for fast reactors as a result of Argonne National Laboratory's integral fast reactor (IFR) concept. This concept involves a novel approach to fuel-cycle closure that is based on metal reprocessing and injection-casting fabrication. This paper delves into recent developments associated with the performance of metallic fuels. In February of 1985, three full assemblies of advanced metallic fuel were placed in the core of the Experimental Breeder Reactor II (EBR-II). The 61-pin assemblies each contained an identical complement of metallic fuel of three compositions: U-10 Zr, U-8 Pu-10 Zr, and U-19 Pu-10 Zr. The pins were clad with the austenitic D9, had linear power rating of 15 kW/ft, and achieved peak cladding temperatures of 600°C. The burnup achieved to date on these pins is 14 at.% burnup without any failures, and the irradiation continues. These lead assemblies have demonstrated that metallic fuels have the potential of being competitive with any existing fuel type in terms of steady-state performance.

52206 **Update on development of the IFR pyroprocess.** Burris, L. (Argonne National Lab., IL (USA)); Miller, W.E.; Gay, E.C.; Ackerman, J.P.; Tomczuk, Z.; Herceg, J.E.; Kann, W.J. *Transactions of the American Nuclear Society (USA),* 56: 68-70 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

A pyrochemical process is under development for recovering and recycling fuel discharged from the integral fast reactor (IFR). In the past year, two major changes have been made in this process. First, the halide slagging step previously used for concentrating plutonium bred in the blanket has been eliminated, not because it did not work but because the same purpose can be achieved by electrorefining. The current flow sheet is shown. Now, all of the necessary separations are achieved by electrorefining alone. Second, to make the electrorefining operations sufficiently flexible to provide the necessary separations while accommodating a range of feed compositions, two types of cathodes are employed. One is used for selective removal of uranium for recycle as blanket material, and the other is used for removal of a uranium-plutonium product for recycle as core material. Computer codes based on thermodynamic models have been developed to predict the fate of product elements (uranium and plutonium) and fission products. These show that high recovery of uranium and plutonium and adequate removal of fission products are achievable.

52207 **Modifications to HFEF/S for IFR fuel cycle demonstration.** Lineberry, M.J.; Phipps, R.D.; Forrester, R.J.; Carnes, M.D.; Rigg, R.H. *Transactions of the American Nuclear Society (USA),* 56: 70-71 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Modifications have begun to the Hot Fuel Examination Facility-South (HFEF/S) in order to demonstrate the technology of the integral fast reactor (IFR) fuel cycle. This paper describes the status of the modifications to the facility and briefly reviews the status of the development of the process equipment. The HFEF/S was the demonstration facility for the early Experimental Breeder Reactor II (EBR-II) melt refining/injection-casting fuel cycle. Then called the Fuel Cycle Facility, ≈400 EBR-II fuel assemblies were recycled in the two hot cells of the facility during the 1964-69 period. Since then it has been utilized as a fuels examination facility. The objective of the IFR fuel cycle program is to upgrade HFEF/S to current standards, install new process equipment, and demonstrate the commercial feasibility of the IFR pyroprocess fuel cycle.

52208 **Technical collaboration between the United States and Japan in the field of liquid-metal reactor reprocessing.** Burch, W.D. (Oak Ridge National Lab., TN (USA)); Stradley, J.G.; Matsumoto, K.; Kishimoto, Y.; Kawata, T. *Transactions of the American Nuclear Society (USA),* 56: 71 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Within the past few months, Japan and the United States have announced an agreement on a new broad research and development collaboration in the nuclear fuel cycle in liquid-metal reactor reprocessing technology. Participants in the overall agreement are the US Department of Energy (DOE) and the Power Reactor and Nuclear Fuel Development Corporation (PNC) of Japan. Technical research and development in the United States will be performed primarily at the Oak Ridge National Laboratory (ORNL), while work in Japan is done by PNC. The agreement is for a research and development collaboration in which the US work will support PNC's breeder reprocessing program and projects. Terms of the agreement call for equitable contributions from PNC and DOE to the technical work done at ORNL. This paper describes the major elements of the technical program and the framework of the Japanese program, which is the basis for the plans and programs.

52209 **Coarse-node computations with an adaptive node structure.** Tzanos, C.P. (Argonne National Lab., IL (USA)). *Transactions of the American Nuclear Society (USA),* 56: 282-283 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The analysis with COMMIX of liquid-metal reactor (LMR) intermediate heat exchanger (IHX) transients characterized by low flows, especially imbalanced low flows, shows that if a coarse-node structure is used, the predicted temperatures are significantly different than those given by a fine-node structure. If a fine-node structure is used for problems that involve a large part of the plant, the computation time becomes excessive. A method of adaptive node structure that resolves such difficulties was presented earlier. This paper presents an improved version of this method. At this stage, this version has been applied only to one-dimensional problems.

2106 Power Reactors, Auxiliary, Mobile, Package, and Transportable

Refer also to citation(s) 52195

52210 (WHC-SA–0727) **Introductory testimony: Hearing on nuclear power in space.** Nolan, J. Westinghouse Hanford Co., Richland, WA (USA). Sep 1989. 61p. Sponsored by U.S. DOE Management & Administration. DOE Contract AC06-87RL10930. Order Number DE90001137. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This report covers the uses of nuclear power in space. Various systems are discussed and an outline of a slide presentation is given. The testing and safety of these programs is also briefly mentioned. (JEF)

2107 Regulation and Licensing

Refer also to citation(s) 52267, 52296, 52330, 52331, 52332, 52333

52211 (KFK–4357) **Public participation in the licensing of large-scale projects with environmental impact. Interim results of a joint research project.** Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Abt. fuer Angewandte Systemanalyse; Hochschule fuer Verwaltungswissenschaften, Speyer (Germany, F.R.). Forschungsinstitut fuer Oeffentliche Verwaltung. Jan 1989. 586p. (In German). Order Number DE90711598. Available from NTIS (US Sales Only), PC A25/MF A01.

As a rule, public participation in licensing and planning procedures for large-scale projects with environmental impact is as controversial as the projects themselves. Against this background, an interdisciplinary examination of several 'cases' of public participation in administrative procedures with varying legal forms is being conducted in a joint research project run by the Department for Applied Systems Analysis (Karlsruher Nuclear Centre) and the Research Institute for Public Administration at the College for Administrative Sciences in Speyer. The actual course of events and the practical experience of the groups involved (authorities, applicants, objectors, experts) are related to the applicable legal arrangements for public participation. The question to be answered is: which expected and unexpected functions do the procedures actually fulfill and which not. Proposals for the amendment of legal policy could be developed upon the foundation of such a diagnosis. The report contains the results of the 'pilot study' on public participation in the licensing of the nuclear power plant GKN-2 in Neckarwestheim and further contributions on the issue of 'public participation', presented within the framework of a research colloquium at the School for Nuclear Technology/Karlsruhe Nuclear Research Centre. (orig.).

52212 (KFK–4357, pp. 29-47) **The functions of participation of the public in administrative procedures concerning large-scale projects.** Ronellenfitsch, M. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Abt. fuer Angewandte Systemanalyse; Hochschule fuer Verwaltungswissenschaften, Speyer (Germany, F.R.). Forschungsinstitut fuer Oeffentliche Verwaltung. Jan 1989. (In German). In *Public participation in the licensing of large-scale projects with environmental impact. Interim results of a joint research project.* Order Number DE90711598. Available from NTIS (US Sales Only), PC A25/MF A01.

On the basis of the concepts of positive law and the dogmatic nature of law, the author examines the functions of participation of the public (purpose, intent) with a view to the type of administrative decisions to be taken, distinguishing between licensing and planning decisions. He discusses in particular the functions of information, participation, pacification, and legal protection. Legal protection is the example revealing the decisive difference in the two types of procedure. Balancing of legal protection is the goal, and if legal protection is made an issue already in the planning procedure, care must be taken to maintain balanced legal protection. (HSCH).

52213 (KFK–4357, pp. 49-68) **Participation of the public and technology policy.** Paschen, H.; Bechmann, G.; Gloede, F. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Abt. fuer Angewandte Systemanalyse; Hochschule fuer Verwaltungswissenschaften, Speyer (Germany, F.R.). Forschungsinstitut fuer Oeffentliche Verwaltung. Jan 1989. (In German). In *Public participation in the licensing of large-scale projects with environmental impact. Interim results of a joint research project.* Order Number DE90711598. Available from NTIS (US Sales Only), PC A25/MF A01.

Public participation is placed in the context of the government's technology policy whose legitimation can be questioned in view of the dispute in our society about technological development and its role in decision for shaping the future of the industrial society. This lack of legitimation has induced a search for instruments that might help to close the acceptance gap. Participation of the public is one of these instruments and is discussed in connection with technology assessment, early warning system, and environmental impact assessment. (HSCH).

52214 (KFK–4357, pp. 71-100) **Participation of the public in the licensing of large-scale projects with environmental impact - theoretical framework and project conceptual outline.** Bechmann, G.; Gloede, F. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Abt. fuer Angewandte Systemanalyse; Hochschule fuer Verwaltungswissenschaften, Speyer (Germany, F.R.). Forschungsinstitut fuer Oeffentliche Verwaltung. Jan 1989. (In German). In *Public participation in the licensing of large-scale projects with environmental impact. Interim results of a joint research project.* Order Number DE90711598. Available from NTIS (US Sales Only), PC A25/MF A01.

The paper discusses the dimensions and environmental impacts of large-scale projects, and public participation as an element of institutionalized problem management. The legal protection functions, the administrative and socio-political functions are subsumed under a concept of function which defines a function as a synthesis of a variety of possibilities, so that different 'achievements' are expected from public participation, depending on the reference system chosen for comparison. The paper explains the purpose of the examination of public participation and its functions, the design of analytical procedure which covers the three main stages of 'input, legal procedure, output', and instruments and aspects such as

interdisciplinarity, representativity, comparison, relation between empirical research and the principles of the law. (HSCH).

52215 (KFK–4357, pp. 101-168) **Structural framework conditions and the case history of public participation in the GKN-2 reactor project.** Gloede, F. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Abt. fuer Angewandte Systemanalyse; Hochschule fuer Verwaltungswissenschaften, Speyer (Germany, F.R.). Forschungsinstitut fuer Oeffentliche Verwaltung. Jan 1989. (In German). In *Public participation in the licensing of large-scale projects with environmental impact. Interim results of a joint research project.* Order Number DE90711598. Available from NTIS (US Sales Only), PC A25/MF A01.

This paper outlines the structural framework conditions of the GKN-2 project, which include the fundamental decision for a peaceful use of nuclear energy, the onset of the nuclear controversy in the early 1970s, and its shift to administrative procedures. The author shows that these general conditions already had an impact on the forerunner project, GKN-1, and the site-specific conflict of interests involved. The review concludes that the procedures have to be designed so as to be adequate to the problems or conflicts involved, and this in the fields of development of political objectives, administration, and adjucation. (orig./HSCH).

52216 (KFK–4357, pp. 169-295) **Public participation in the licensing procedure for GKN-2: The parties involved, communicative and interactive structures, administrative appraisal.** Schmittel, W. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Abt. fuer Angewandte Systemanalyse; Hochschule fuer Verwaltungswissenschaften, Speyer (Germany, F.R.). Forschungsinstitut fuer Oeffentliche Verwaltung. Jan 1989. (In German). In *Public participation in the licensing of large-scale projects with environmental impact. Interim results of a joint research project.* Order Number DE90711598. Available from NTIS (US Sales Only), PC A25/MF A01.

The paper discusses the procedure which is divided into three phases: public participation during the phase of official announcement and information, during the phase of hearing, and in the course of the administrative appraisal of the project. Three leading questions can thus be answered, concerning the specific situation or interests of parties raising objections, the communicative or interactive structures of the three groups involved (authority, objector, applicant), and the effect of objections. The author discusses conflict causing types of communication and procedural imbalance - i.e. cooperative behaviour between authority and applicant on the one hand, and sovereign behaviour of administrative authorities towards objectors on the other, which leads to putting the question of whether the procedure is capable of fulfilling the functions of an element for maintaining order, and as a regulatory instrument. The paper finally presents information on the methodical approach used for the (quantitative and qualitative) 'document analysis' which has been made of the minutes of the public hearing on GKN-2, which covers 4.000 pages. (orig./HSCH).

52217 (KFK–4357, pp. 297-318) **Analysis of the press reports on the GKN-2 hearing.** Gloede, F. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Abt. fuer Angewandte Systemanalyse; Hochschule fuer Verwaltungswissenschaften, Speyer (Germany, F.R.). Forschungsinstitut fuer Oeffentliche Verwaltung. Jan 1989. (In German). In *Public participation in the licensing of large-scale projects with environmental impact. Interim results of a joint research project.* Order Number DE90711598. Available from NTIS (US Sales Only), PC A25/MF A01.

The press reports of the 'Heilbronner Stimme' have been examined exclusively applying the means of quantitative analysis of contents, aiming at showing the selection of subjects, and how they were treated in the regional press. The newspaper under review was the most comprehensive and detailed source of information available to the population in that area. Seen against the background of the actual participation of the public in the hearing, the unavoidably selective treatment of subjects in the press seems to have been adequate to the social and political quality of the discussions. This result is significant considering that the general public in that area primarily derived information on this topic from the press. (orig./HSCH).

52218 (KFK–4357, pp. 319-456) **Public participation in the licensing of large-scale projects with environmental impact. The point of view of the population. Results of an opinion poll in the region of the GKN-2 site.** Gloede, F.; Buecker-Gaertner, H. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Abt. fuer Angewandte Systemanalyse; Hochschule fuer Verwaltungswissenschaften, Speyer (Germany, F.R.). Forschungsinstitut fuer Oeffentliche Verwaltung. Jan 1989. (In German). In *Public participation in the licensing of large-scale projects with environmental impact. Interim results of a joint research project.* Order Number DE90711598. Available from NTIS (US Sales Only), PC A25/MF A01.

The paper explains purpose, concept and methods of the poll, the structures of the pattern of opinions given, and th causes of opinion forming and overlapping patterns of orientation. A significant aspect observed is that irrespective of differentiation in the opinion forming process among the regional population, public participation seems to have only little legitimatory effect. Applicants as well as authorities meet with distrust on the part of the public, caused by the (subjective feeling) of discrepany between decision-relevant or 'licence-relevant, and social preferences. There is the common feeling that the interests of the population are only sometimes taken into account, and the public's power to influence decisions is very limited. This is why over two thirds of the regional population sees a need for modification of the practical execution of the procedures, and of the legal provisions. (orig./HSCH).

52219 (KFK–4357, pp. 459-470) **The nuclear licensing procedure for unit 2 of the Neckar reactor station, GKN-2. Practical experience and an attempt to make an evaluation from the legal science point of view.** Lang, S. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Abt. fuer Angewandte Systemanalyse; Hochschule fuer Verwaltungswissenschaften, Speyer (Germany, F.R.). Forschungsinstitut fuer Oeffentliche Verwaltung. Jan 1989. (In German). In *Public participation in the licensing of large-scale projects with environmental impact. Interim results of a joint research project.* Order Number DE90711598. Available from NTIS (US Sales Only), PC A25/MF A01.

Public participation came up to formal requirements in this case, but in fact the participation procedure had weak points in terms of function, except for the function of indirect protection of the applicant, which in the final analysis is based on the public invitation to assert claims by way of public participation (disciplinary function). This protection could be achieved also if anybody were entitled to raise objections in writing, and if, during the hearing, the potentially affected persons had the right to explain their objections. Apart from that, it must be said that public participation in this case was not very efficiently made use of in the discussions about technical facts, as participation restricted itself to repeated statement of fear and doubt, and reiteration of questions. (orig./HSCH).

52220 (KFK–4357, pp. 471-483) **The public hearing procedure between hearing and debate.** Bechmann, G. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Abt. fuer Angewandte Systemanalyse; Hochschule fuer Verwaltungswissenschaften, Speyer (Germany, F.R.). Forschungsinstitut fuer Oeffentliche Verwaltung. Jan 1989. (In German). In *Public participation in the licensing of large-scale projects with environmental impact. Interim results of a joint research project.* Order Number DE90711598. Available from NTIS (US Sales Only), PC A25/MF A01.

In the real procedure, three communication models differing in tendency are colliding, each model being represented pars pro toto by the various groups taking part in the procedure. The licensing authority acts on the basis of a one-way communication scheme anchored in the traditional legal institution of a public hearing. The group of applicants predominantly uses the model of communication from a defined position, based on the assumption of being competent in matters of science and technology. The group of objectors frequently conjures the model of discursive communication, hoping to soften rigid attitudes of the authority or the applicants, in order to make the planning procedure more reversibel. The conflicting communicative structures reveal another source of conflict, which lies in the controversial interpretation of legal rules and provisions. (orig./HSCH).

52221 (KFK–4357, pp. 485-494) **Participation of the public in the nuclear licensing procedure, as seen by an experienced administrative officer.** Blickle, D. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Abt. fuer Angewandte Systemanalyse; Hochschule fuer Verwaltungswissenschaften, Speyer (Germany, F.R.). Forschungsinstitut fuer Oeffentliche Verwaltung. Jan 1989. (In German). In *Public participation in the licensing of large-scale projects with environmental impact. Interim results of a joint research project.* Order Number DE90711598. Available from NTIS (US Sales Only), PC A25/MF A01.

The author is an administrative officer of a licensing authority. From his point of view, there is no concrete reason to call for a modification of the legal provisions concerning the participation of the public. The legal provisions are stated to be sufficient and suitable for the task to be fulfilled, i.e. to provide for a hearing. Communication problems are said to be due to attempts of misusing hearings as a platform for questioning the peaceful use of nuclear energy altogether. (orig./HSCH).

52222 (KFK–4357, pp. 495-526) **Structural problems of public participation in large-scale projects with environmental impact.** Bechmann, G. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Abt. fuer Angewandte Systemanalyse; Hochschule fuer Verwaltungswissenschaften, Speyer (Germany, F.R.). Forschungsinstitut fuer Oeffentliche Verwaltung. Jan 1989. (In German). In *Public participation in the licensing of large-scale projects with environmental impact. Interim results of a joint research project.* Order Number DE90711598. Available from NTIS (US Sales Only), PC A25/MF A01.

Four items are discussed showing that the problems involved through participation of the public in large-scale projects with environmental impact cannot be solved satisfactorily without suitable modification of the existing legal framework. The problematic items are: the status of the electric utilities as a quasi public enterprise; informal preliminary negotiations; the penetration of scientific argumentation into administrative decisions; the procedural concept. The paper discusses the fundamental issue of the problem-adequate design of the procedure and develops suggestions for a cooperative participation design. (orig./HSCH).

52223 (KFK–4357, pp. 527-533) **The social conflict about nuclear energy and the procedure of public participation - theses explaining the demand for operative acts.** Gloede, F. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Abt. fuer Angewandte Systemanalyse; Hochschule fuer Verwaltungswissenschaften, Speyer (Germany, F.R.). Forschungsinstitut fuer Oeffentliche Verwaltung. Jan 1989. (In German). In *Public participation in the licensing of large-scale projects with environmental impact. Interim results of a joint research project.* Order Number DE90711598. Available from NTIS (US Sales Only), PC A25/MF A01.

(1) The opinion of the population on the participation procedure depends on its judgement of the project. (2) Judgement of the leading groups taking part in the procedure is an independent factor. (3) The fundamental disagreement about the use of nuclear energy cannot be adjusted by administrative procedures. (4) The gradational disagreement about nuclear engineering projects suggests a procedural reform. (5) Political settlement of the fundamental controversy and reforms of the public participation procedure cannot be substituted one for the other. (6) There is a social and political interaction between the fundamental and the gradational disagreement. (orig.).

52224 (KFK–4357, pp. 535-544) **Procedural modifications for public participation in the licensing of large-scale projects with environmental impacts?.** Wenz, E.M. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Abt. fuer Angewandte Systemanalyse; Hochschule fuer Verwaltungswissenschaften, Speyer (Germany, F.R.). Forschungsinstitut fuer Oeffentliche Verwaltung. Jan 1989. (In German). In *Public participation in the licensing of large-scale projects with environmental impact. Interim results of a joint research project.* Order Number DE90711598. Available from NTIS (US Sales Only), PC A25/MF A01.

The need for procedural modifications is explained by arguments of social pyschology. The goal is not to abandon too early the pacification potential of public participation. The recommended means are: establishment of institutions assisted by experts; appointment of representatives of the population; selection of representatives according to professional and subject-related competence. (HSCH).

52225 (KFK–4357, pp. 547-572) **Requirements of the law concerning participation of foreigners from neighbour countries in nuclear licensing procedures.** Lang, S. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Abt. fuer Angewandte Systemanalyse; Hochschule fuer Verwaltungswissenschaften, Speyer (Germany, F.R.). Forschungsinstitut fuer Oeffentliche Verwaltung. Jan 1989. (In German). In *Public participation in the licensing of large-scale projects with environmental impact. Interim results of a joint research project.* Order Number DE90711598. Available from NTIS (US Sales Only), PC A25/MF A01.

The existing ordinance on the procedure for licensing nuclear installations can be interpreted so as to need only a few amendments in order to comply with the latest decisions of the Federal Administrative Court. Further modifications should be laid down in bilateral or multilateral agreements, which ought to keep in mind the goal of harmonization of the German law on environmental protection and procedures and, in the long run, an approach of the legal systems in this field in the European Community. (orig./HSCH).

52226 (NUREG–0040-Vol.13-No.2) **Licensee contractor and vendor inspection status report: Quarterly report, April 1989–June 1989.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Inspection and Safeguards. Aug 1989. 43p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A04/MF A01 - GPO - OSTI.

This periodical covers the results of inspection performed by the NRC's Vendor Inspection Branch that have been distributed to the inspected organizations during the period from April 1989 through June 1989.

52227 (NUREG–0750-Vol.29-Index-2) **Indexes to Nuclear Regulatory Commission issuances, January–June 1989.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services. Sep 1989. 74p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A04/MF A01 - GPO; OSTI; INIS.

Digests and indexes for issuances of the Commission, the Atomic Safety and Licensing Appeal Panel, the Atomic Safety and Licensing Board Panel, the Administrative Law Judge, the Directors' Decisions, and the Denials of Petitions of Rulemaking are presented in this document. The information elements are displayed in one or more of five separate formats. These formats are case named index digests and headers, legal citations index, subject index, and facility index.

52228 (NUREG–0940-Vol.8-No.2) **Enforcement actions: Significant actions resolved: Quarterly progress report, April–June 1989.** Nuclear Regulatory Commission, Washington, DC (USA). Office of Enforcement. Sep 1989. 387p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A17/MF A01 - GPO - OSTI.

This compilation summarizes significant enforcement actions that have been resolved during one quarterly period (April–June 1989) and includes copies of letters, Notices, and Orders sent by the Nuclear Regulatory Commission to licenses with respect to these enforcement actions. It is anticipated that the information in this publication will be widely disseminated to managers and employees engaged in activities licensed by the NRC, so that actions can be taken to improve safety by avoiding future violations similar to those described in this publication.

52229 (NUREG–0980-Rev.4) **Nuclear Regulatory Legislation.** Nuclear Regulatory Commission, Washington, DC (USA). Office of the General Counsel. Aug 1989. 226p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A11/MF A01 - GPO - OSTI.

This compilation of statutes and material pertaining to nuclear regulatory legislation through the 100th Congress, 2nd Session, has been prepared by the Office of the General Counsel, US Nuclear Regulatory Commission, with the assistance of staff, for use as an internal resource document. Persons using this document are placed on notice that it may not be used as an authoritative citation in lieu of the primary legislative sources. Furthermore, while every

effort has been made to ensure the completeness and accuracy of this material, neither the United States Government, the Nuclear Regulatory Commission, nor any of their employees makes any expressed or implied warranty or assumes liability for the accuracy or completeness of the material presented in this compilation.

52230 (NUREG/CR–2000-Vol.8-No.8) **Licensee Event Report (LER) compilation for month of August 1989.** Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data; Oak Ridge National Lab., TN (USA). Sep 1989. 152p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. (ORNL/NSIC–200-Vol.8-No.8). Available from NTIS, PC A08/MF A01 - GPO; OSTI; INIS.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the one month period identified on the cover of the document. The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. Procedures for LER reporting for revisions to these events occurring prior to 1984 are described in NRC Regulatory Guide 1.16 and NUREG-0161, Instructions for Preparation of Data Entry Sheets for Licensee Event Reports. For those events occurring on and after January 1, 1984, LERs are being submitted in accordance with the revised rule contained in Title 10 Part 50.73 of the Code of Federal Regulations (10 CFR 50.73 – Licensee Event Report System) which was published in the Federal Register (Vol. 48, No. 144) on July 26, 1983. NUREG-1022, Licensee Event Report System – Description of Systems and Guidelines for Reporting, provides supporting guidance and information on the revised LER rule.

2108 Economics

Refer also to citation(s) 52301, 52332, 52339

52231 **A European perspective on the US nuclear fuel cycle.** Wilkinson, W.L. *Transactions of the American Nuclear Society (USA),* 58: 91-93 (1989). (CONF-8810179–: International conference on nuclear fission: fifty years of progress in energy security, Washington, DC (USA), 30 Oct - 4 nov 1988).

Many Europeans believe that the main problems which have impeded progress in solving the back end of the nuclear fuel cycle in the United States have been a series of ideological and political hang-ups and these, coupled with excessive bureaucracy, have made logical decision making on the back-end problems impossible. This situation has been caused by a succession of political nondecisions. Public confidence in nuclear generation was thereby undermined and, because of plentiful supplies of other energy sources, there was no urgent need to expand the nuclear program in the United States. Since uranium was cheap and fast reactors not commercially attractive, there was no economic incentive to reprocess fuel from existing reactors in the United States. The problem facing the United States is that of managing the large stocks of spent fuel which have arisen over many years. A logical way forward for the United States would appear to be as follows: build more storage for spent fuel; consider overseas reprocessing to provide plutonium; develop reprocessing technology; and develop direct disposal technology.

52232 **Nuclear fuel cycle cost in the face of uncertainty.** Schwartz, M.H.; Meade, T.B.; Sonz, L.A.; Diafero, F.J. Jr. *Transactions of the American Nuclear Society (USA),* 56: 97-98 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Long-term planning and decision making are a major part of the utility fuel manager's responsibilities. The proper performance of these responsibilities is made that much more challenging by the many uncertainties that encumber the world in which he must work. A proper appreciation for the sensitivity of nuclear fuel costs to the myriad of factors that can and do affect these costs can be best achieved through the application of probabilistic modeling techniques. The methodology to perform such an analysis has been formalized in the menu-driven, personal computer based program, PROBCOST. PROBCOST facilitates a quantitative analysis of these uncertainties and enables the fuel manager to better evaluate the relative contribution of various factors to the total nuclear fuel cost.

52233 **Low incremental costs mean base-loaded nuclear reactors.** Schmidt, R.A. Jr. *Transactions of the American Nuclear Society (USA),* 56: 114-115 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The large increase in the operating costs of nuclear reactors is sufficient reason to reexamine the basis of loading nuclear plants. Average operating and management (O&M) costs for nuclear plants in the Untied States have increased in the past decade from approximately $2/MWh to $11/MWh. In contrast, average O&M costs of coal plants have held relatively steady in the $3 to $4/MWh range. The production costs of nuclear plants (where production costs are defined as the sum of O&M and fuel costs) are nearly as high as the production costs of coal plants. These circumstances then are the reason for the following question: On weekends and/or during nightly low-demand periods, should we back off on the loads of nuclear plants? Fossil plants have been loaded (and unloaded) on the basis of incremental costs for many decades. The incremental cost approach must also be used on nuclear plants-to answer the question of night/weekend load-reduction duty. The two components of incremental production costs are fuel costs and O&M costs. In summary, operating nuclear plants should continue on base-load duty because of their low incremental production costs.

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory and Calculation

Refer also to citation(s) 52327, 52340, 52342, 52356, 52357, 53868, 53870

52234 (CNIC–00195) **Finite element analysis of neutron diffusion equations and reactor core fuel management.** Huang Aixiang; Huang Qinghuai; Tang Yuren; Tu Zhuguo. China Nuclear Information Centre, Beijing, BJ (China). Apr 1988. 16p. (In Chinese). Order Number DE90605395. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The mathematical formulation for operation and reactor core fuel management was studied. Using time discrimination, the eigenvalue problem of neutron diffusion equations are governed by reactivity gain in the reactor. From the distribution of neutron flux, power and irradiation, the regulating critical state and fuel management can be described as inverse problem of mathematical physics. The computing simulation of above full procedure was also provided. In addition, a finite element method with proposal accelerating convergence method to eigenvalue problem of neutron diffusion equations was used. The computing time is saved greatly and the convergence speed is much faster compared with other codes for same kind of benchmark problem in the world.

52235 (JAERI-M–89-072) **Nuclear characteristic analyses of TRU burner reactors. Design study on TRU transmutation reactors, 2.** Takano, Hideki; Mukaiyama, Takehiko; Takizuka, Takakazu; Ogawa, Toru; Gunji, Yasuyosi; Osakabe, Masahiro. Japan Atomic Energy Research Inst., Tokyo (Japan). Jun 1989. 82p. (In Japanese). Order Number DE90710071. Available from NTIS (US Sales Only), PC A05/MF A01.

To study conceptual design of TRU burner reactors, nuclear characteristic analyses have been performed. Two kind of reactors for Na-cooled alloy fuel assembly and He-cooled particle fuel assembly have been proposed as potential transmutation system for TRU waste nuclides. To perform neutronic calculations for these reactor cores, group constant library and burnup calculation code for TRU nuclides have been produced. In the Na-cooled TRU alloy fuel burner reactor, the fuel and core specifications in which the maximum temperature limited for fuel and cladding are satisfied were obtained by the parametric calculations for fuel elements, core geometry, power distribution and reactor power. Furthermore, power flattening and burnup reactivity swing reduction have been studied. As the result, two-region core was obtained, in which the fuel

compositions were 58Np-22Pu-20Zr for inner core and 60AmCm-35Pu-5Y for outer core. The presently designed core is the thermal power of 170 MW and can transmute TRU of 47 kg per year. A reactor system of six-modular-cores can transmute TRU of 260 kg which are generated from ten PWRs per year. In the He-cooled particle fuel burner reactor, the fuel particles are packed between two concentric porous cylinders of HT-9 with a multitude of small holes to make annular fuel elements (frits). The reactor core was designed by considering the maximum temperature (1000deg K) of central fuel particle and fast neutron fluence of 3.5 x 10^{23} (n/cm^2) during each burnup cycle. This reactor with thermal power of 1200 MW can obtain high transmutation rate of 17 % per 300 days. TRU nuclides have large uncertainties for nuclear and physics data, and the effect of these uncertainties on the nuclear characteristics were studied. (author).

52236 (ORNL/FTR–3396) **[Meeting of the NEANDC Task Force on decay heat predictions]: Foreign trip report, September 21, 1989–September 22, 1989.** Dickens, J.K. Oak Ridge National Lab., TN (USA). 4 Oct 1989. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90001247. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler participated in the OECD-sponsored Task Force meeting on Decay Heat Predictions and provided oral progress reports on the status of the upcoming renewal of the US ANS-5.1 Decay Heat Standard and on some recent ORNL work involving comparisons of calculated with experimental beta-ray spectra. The Task Force was unable to complete its primary goals of resolving discrepancies among experimental data and among calculational predictions although some progress has been made on the latter goal. The traveler also learned of potential effects on nuclear research in Great Britain because of the pending breakup of the Central Electricity Generating Board.

52237 **IEEE [Institute of Electrical and Electronics Engineers] standards and nuclear software quality engineering.** Daughtrey, T. *Transactions of the American Nuclear Society (USA),* 56: 266-267 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Significant new nuclear-specific software standards have recently been adopted under the sponsorship of the American Nuclear Society and the American Society of Mechanical Engineers. The interest of the US Nuclear Regulatory Commission has also been expressed through their issuance of NUREG/CR-4640. These efforts all indicate a growing awareness of the need for thorough, referenceable expressions of the way to build in and evaluate quality in nuclear software. A broader professional perspective can be seen in the growing number of software engineering standards sponsored by the Institute of Electrical and Electronics Engineers (IEEE) Computer Society. This family of standards represents a systematic effort to capture professional consensus on quality practices throughout the software development life cycle. The only omission-the implementation phase-is treated by accepted American National Standards Institute or de facto standards for programming languages.

52238 **The impact of changing computing technology on EPRI [Electric Power Research Institute] nuclear analysis codes.** Breen, R.J. *Transactions of the American Nuclear Society (USA),* 56: 267-268 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The Nuclear Reload Management Program of the Nuclear Power Division (NPD) of the Electric Power Research Institute (EPRI) has the responsibility for initiating and managing applied research in selected nuclear engineering analysis functions for nuclear utilities. The computer systems that result from the research projects consist of large FORTRAN programs containing elaborate computational algorithms used to access such areas as core physics, fuel performance, thermal hydraulics, and transient analysis. This paper summarizes a study of computing technology trends sponsored by the NPD. The approach taken was to interview hardware and software vendors, industry observers, and utility personnel focusing on expected changes that will occur in the computing industry over the next 3 to 5 yr. Particular emphasis was placed on how these changes will impact engineering/scientific computer code development, maintenance, and use. In addition to the interviews, a workshop was held with attendees from EPRI, Power Computing Company, industry, and utilities. The workshop provided a forum for discussing issues and providing input into EPRI's long-term computer code planning process.

52239 **A company perspective on software engineering standards.** Steer, R.W. *Transactions of the American Nuclear Society (USA),* 56: 268-269 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Software engineering standards, as implemented via formal policies and procedures, have historically been used in the nuclear industry, especially for codes used in the design, analysis, or operation of the plant. Over the past two decades, a significant amount of software has been put in place to perform these functions, while the overall software life cycle has become better understood, more and different computer systems have become available, and industry has become increasingly aware of the advantages gained when these procedures are used in the development and maintenance of this large amount of software. The use of standards and attendant procedures is thus becoming increasingly important as more computerization is taking place, both in the design and the operation of the plant. It is difficult to categorize software used in activities related to nuclear plants in a simple manner. That difficulty is due to the diversity of those uses, with attendant diversity in the methods and procedures used in the production of the software, compounded by a changing business climate in which significant software engineering expertise is being applied to a broader range of applications on a variety of computing systems. The use of standards in the various phases of the production of software thus becomes more difficult as well. This paper discusses the various types of software and the importance of software standards in the development of each of them.

52240 **NRC [Nuclear Regulatory Commission] perspective of software QA [quality assurance] in the nuclear history.** Weiss, S.H. *Transactions of the American Nuclear Society (USA),* 56: 269 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Computer technology has been a part of the nuclear industry since its inception. However, it is only recently that computers have been integrated into reactor operations. During the early history of commercial nuclear power in the United States, the US Nuclear Regulatory Commission (NRC) discouraged the use of digital computers for real-time control and monitoring of nuclear power plant operation. At the time, this position was justified since software engineering was in its infancy, and horror stories on computer crashes were plentiful. Since the advent of microprocessors and inexpensive computer memories, significant advances have been made in fault-tolerant computer architecture that have resulted in highly reliable, durable computer systems. The NRC's requirement for safety parameter display system (SPDS) stemmed form the results of studies and investigations conducted on the Three Mile Island Unit 2 (TMI-2) accident. An NRC contractor has prepared a handbook of software QA techniques applicable to the nuclear industry, published as NUREG/CR-4640 in August 1987. Currently, the NRC is considering development of an inspection program covering software QA. Future efforts may address verification and validation as applied to expert systems and artificial intelligence programs.

52241 **A simplified method for analyzing pressure loss uncertainty in reactor assemblies.** Vilim, R.B. (Argonne National Lab., IL (USA)). *Transactions of the American Nuclear Society (USA),* 56: 285-287 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

An approximate but accurate method has been developed for estimating the uncertainty in assembly pressure loss when the loss coefficients are in linear regression form. Although more exact Monte Carlo and convolution integral approaches exist, these approaches require detailed numerical solution and are therefore inappropriate for design work. By comparison, the method proposed in this paper has a closed form analytic solution. The method is analogous to the hot channel factor methods used in core design. The intent of this paper is (a) to describe the state of the art as it exists for modeling pressure loss for flow in a closed channel, (b) to develop a method for estimating the two-sigma pressure loss over

the length of a series of such channels and give the conditions under which the method gives accurate results, and (c) to present results for a reference problem.

52242 Multigrid methods for diffusion equations with highly discontinuous coefficients. Dendy, J.E. Jr. (Los Alamos National Lab., CA (USA)). *Transactions of the American Nuclear Society (USA),* 56: 290 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The subject of this paper is the numerical solution by multigrid methods of $-\nabla\cdot D(x)\nabla U(x) + \sigma(x)U(x) = F(x)$, $x\in\Omega$ and $v(x)\cdot D(x)\nabla U(x) + \gamma(x)U(x) = 0$, $x \in \delta\Omega$, where Ω is a bounded region in R^2 or R^3 with boundary $\delta\Omega$, D^j is positive, σ and γ are nonnegative, and D^j, σ, and F are allowed to be discontinuous across internal boundaries Γ of Ω.

52243 A multigrid method for S_N calculations in x-y geometry. Nowak, P.F. (Lawrence Livermore National Lab., CA (USA)); Larsen, E.W.; Martin, W.R. *Transactions of the American Nuclear Society (USA),* 56: 291-292 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The standard source iteration method for obtaining iterative solutions of S_N problems is known to converge slowly in optically thick, diffusive regions. Consequently, a class of acceleration schemes, synthetic methods, has been developed that has greatly increased the efficiency of S_N calculations. The basic principle in the synthetic method is to use a suitable low-order operator to accelerate an iteration with a high-order operator. Initially, the low-order operator was a diffusion operator, which yielded a method known as diffusion-synthetic acceleration (DSA). Unfortunately, for the DSA method to be implemented in a stable fashion, a particular set of acceleration equations is required, which may be difficult to solve efficiently for complicated discretization schemes (e.g., nodal methods). Thus, in x-y geometry, DSA has only been implemented for the diamond-differenced S_N equations. An effective means of accelerating iteration schemes, which (until now) has been almost exclusively applied to elliptic equations, is the multigrid method. The authors present a multigrid algorithm for solving low-order transport operators; specifically, a multigrid algorithm is used to solve the pseudo-S_2 (PS_2) equations, which result from a BPA method that was presented previously.

52244 Variational formulation of a higher order nodal diffusion method. Tomasevic, D.; Altiparmakov, D. *Transactions of the American Nuclear Society (USA),* 56: 294-296 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Transverse integration procedures are used in most modern nodal computer codes that were developed in the late seventies in order to obtain a faster solution of the multidimensional neutron diffusion equation. The method of reduction to ordinary differential equations earlier formulated by Kantorovich and Krylov, however, has a more general form. Compared to Ritz-Galerkin methods, the advantage is that only a part of the trial function is chosen a priori and part has to be determined in accordance with the character of the problem. This fact results in remarkably greater accuracy. Following the method of Kantorovich, higher order quasi-one-dimensional nodal equations are formulated in this paper. In addition, the difference from a recently published similar approach is pointed out.

52245 The solution to the nuclear reactor kinetic equations with a continuous slowing down model using numerical Laplace transform inversion. Ravetto, P.; Sumini, M.; Ganapol, B.D. *Transactions of the American Nuclear Society (USA),* 56: 310-311 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

In an attempt to better understand the influence of prompt and delayed neutrons on nuclear reactor dynamics, a continuous slowing down model based on Fermi age theory was developed several years ago. This model was easily incorporated into the one-group diffusion equation and provided a realistic physical picture of how delayed and prompt neutrons slow down and simultaneously diffuse throughout a medium. The model allows for different slowing down times for each delayed neutron group as well as for prompt neutrons and for spectral differences between the two typed of neutrons. Because of its generality, this model serves not only a a useful predictive tool to anticipate reactor transients, but also as an excellent educational tool to demonstrate the effect of delayed neutrons in reactor kinetics. However, because of numerical complications, the slowing down model could not be developed to its full potential. In particular, the major limitation was the inversion of the Laplace transform, which relied on a knowledge of the poles associated with the resulting transformed flux. For this reason, only one group of delayed neutrons and times longer than the slowing down times could be considered. As is shown, the new inversion procedure removes the short time limitation as well as allows for any number of delayed neutron groups. The inversion technique is versatile and is useful in teaching numerical methods in nuclear science.

52246 An improved Dancoff correction factor for the SCALE code system. Jordan, W.C. (Oak Ridge National Lab., TN (USA)); Parks, C.V.; Petrie, L.M. *Transactions of the American Nuclear Society (USA),* 56: 324-325 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The SCALE code system has become a major tool for criticality safety analyses. Sequences within SCALE are automated to provide resonance self-shielding (via BONAMI and/or NITAWL) prior to calculation of k_{eff} by KENO V.a or XSDRNPM. This paper presents a modification to the Dancoff correction factor formalism used by NITAWL. The modified Dancoff factor treatment eliminates a breakdown observed in the past, which had been previously attributed to the limitations of the Nordheim treatment utilized by NITAWL.

2202 Components and Accessories

Refer also to citation(s) 52141, 52226, 52258, 52264, 52272, 52300, 52339

52247 (CEGB-RD/L–3342/R88) **STEM - software test and evaluation methods: fault detection using static analysis techniques.** Bishop, P.G.; Esp, D.G. Central Electricity Research Labs., Leatherhead (UK). Aug 1988. 33p. Order Number DE90606781. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

STEM is a software reliability project with the objective of evaluating a number of fault detection and fault estimation methods which can be applied to high integrity software. This Report gives some interim results of applying both manual and computer-based static analysis techniques, in particular SPADE, to an early CERL version of the PODS software containing known faults. The main results of this study are that: The scope for thorough verification is determined by the quality of the design documentation; documentation defects become especially apparent when verification is attempted. For well-defined software, the thoroughness of SPADE-assisted verification for detecting a large class of faults was successfully demonstrated. For imprecisely-defined software (not recommended for high-integrity systems) the use of tools such as SPADE is difficult and inappropriate. Analysis and verification tools are helpful, through their reliability and thoroughness. However, they are designed to assist, not replace, a human in validating software. Manual inspection can still reveal errors (such as errors in specification and errors of transcription of systems constants) which current tools cannot detect. There is a need for tools to automatically detect typographical errors in system constants, for example by reporting outliers to patterns. To obtain the maximum benefit from advanced tools, they should be applied during software development (when verification problems can be detected and corrected) rather than retrospectively. (author).

52248 (ORNL/FTR–2526) **[Computational analysis of dynamic crack run-arrest phenomena in reactor pressure vessel steels]: Foreign trip report, March 27, 1987–April 17, 1987.** Bass, B.R. Oak Ridge National Lab., TN (USA). 28 Apr 1987. 11p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. Order Number DE89017294. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler visited Kernforschungszentrum Karlsruhe (KFK), Federal Republic of Germany (FRG) to confer with Dr. H.K. Stamm and other staff members to accomplish several objectives that relate to the computational analysis of dynamic crack run-arrest phenomena in reactor implementation which is the product of approximately

three years of KFK work in the area of unified constitutive theories for rate-dependent materials. In exchange, the traveler would discuss with KFK a computer implementation of five elastic and inelastic candidate fracture parameters utilized in the ORNL ADINA computer program for elasto-dynamic and viscoplastic-dynamic fracture analysis. An essential feature of this exchange would be in-depth discussions with the KFK staff concerning implementation, application, and future development of these computational techniques.

52249 (ORNL/FTR–2568) **[Structural mechanics in reactor technology and concrete aging]: Foreign trip report, August 8–26, 1987.** Pugh, C.E.; Naus, D.J. Oak Ridge National Lab., TN (USA). 21 Sep 1987. 30p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. Order Number DE89017307. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The travelers met with staff members of the United Kingdom Atomic Energy Authority (Risley), the UK Central Electricity Generating Board (Leatherhead), the Staatliche Materialprufungsanstalt (Universitaet Stuttgart), the Swiss Federal Institute for Reactor Research (Wuerenlingen), and the Joint Research Center of Commission of European Communities (Ispra) to obtain first-hand information about ongoing R&D programs in support of light-water reactor pressure vessel integrity. Meetings pertaining to aging of concrete components were also held with members of the staffs at Taywood Engineering (London) and Central Electricity Generating Board (Leatherhead). The travelers also participated in the 9th International Conference on Structural Mechanics in Reactor Technology (SMiRT), and the post-SMiRT seminar on containment of nuclear reactors was attended. Contacts with the research laboratories will provide an improved basis for future exchange of information, and some steps were taken to explore potential cooperative research programs. It should be noted that each laboratory visited volunteered interest in the development of cooperative programs. Information obtained during this trip will benefit the ongoing NRC research programs by updating ORNL on the status of research programs in Europe, and also by strengthening acquaintances with counter-parts in other countries, thus enhancing the basis for possible international cooperation.

52250 (ORNL/FTR–2759) **[Implications of radiation-induced embrittlement for the integrity of pressure vessels]: Foreign trip report, November 2–10, 1987.** Iskander, S.K. Oak Ridge National Lab., TN (USA). 30 Nov 1987. 14p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. Order Number DE89017282. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler lectured at the International Course on Implications of Radiation-Induced Embrittlement for the Integrity of Pressure Vessels held at Mar del Plata, Argentina, October 26 through November 13, 1987. The course was jointly sponsored by the International Atomic Energy Agency (IAEA) and the Argentinean Commission Nacional de Energia Atomica (CNEA). The 30 "student" participants were from 17 nations and the 9 lecturers were from the United Kingdom, Germany, Czechoslovakia, and the United States. The traveler lectures on several topics dealing with various aspects of experimental and analytical fracture mechanics using experience gained during a 14-year association with the US Nuclear Regulatory Commission (NRC) sponsored Heavy-Section Steel Technology (HSST) Program. This may contribute to an increased awareness of some of the safety-related issues of pressure vessel integrity. The cost of this trip was borne by the IAEA.

52251 **A study of material transfer under the influence of a magnetic field by the PIXE technique.** Indrukhya, R.; Muju, M.K.; Ram, K.S. *Transactions of the American Nuclear Society (USA)*, 56: 252-253 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Metallic wear and surface deterioration in the presence of a magnetic field has been studied by a limited number of researchers. Based on the experimental studies, it is postulated that the magnetic field basically influences the adhesive wear characteristic of the rubbing components, and the relative magnetic permeabilities and hardness seem to be the predominant factors. Magnetic field influences the mobilities of the dislocation, which in turn influences the diffusivity, leading to different hardness gradients at the surface. It has also been reported that the ball bearings in electrical machines show surface deterioration when a large magnetic field is present. The objective of the present work is to identify experimentally the adhesive transfer of iron (work piece) into a tungsten carbide ball (tool) under various rubbing speeds in the presence of magnetic fields.

2203 Fuel Elements

Refer also to citation(s) 52284, 52285, 52882, 52883, 52884

52252 **A new method for UF_6 conversion to UO_2 with excellent characteristics.** Onoue, T.; Yato, T.; Tanaka, H. *Transactions of the American Nuclear Society (USA)*, 56: 90-91 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Several wet and dry methods for the conversion of UF_6 to UO_2 powder, e.g., the ammonium diuranate (ADU) process and the integrated dry route process, have been developed to an industrial scale. Although the UO_2 powders fabricated by conventional methods have good ceramic characteristics, there is room for improvement. To extend burnup of nuclear fuel, a decrease in fission gas release from UO_2 pellets is required. It has been considered that large-grain pellets satisfy this requirement, but it is difficult to obtain such large-grain pellets by using conventional UO_2 powder. A new method has been developed to produce a highly active UO_2 powder that can greatly contribute to improvement of the fabrication process of nuclear fuel pellet. By using this highly active UO_2 powder, large-grain pellets can be made easily, and low-temperature sintering can be achieved.

2204 Control Systems

Refer also to citation(s) 52335, 54072

52253 (INIS-BR–1651) **Irradiation effects in fused quartz 'Suprasil' as a detector of fission fragments under high flux of reactor neutrons.** Moraes, O.M.G. de. Pontificia Univ. Catolica do Rio de Janeiro, RJ (Brazil). Dept. de Quimica. 1984. 189p. (In Portuguese). Order Number DE90606783. Available from NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS.

A systematic study about the registration characteristics of synthetic fused quartz 'Suprasil I' use as a detector of fission fragments under high flux of reactor neutrons and the effects of irradiation on it was performed. Fission fragments of ^{252}Cf, gamma radiation doses of of ^{60}Co up to 150 MGy, and integrated neutrons fluxes up to 10^{20} n/cm^2 were used. A model to explain the effects on track registration and development characteristics of 'Suprasil I' irradiated on reactors were proposed, based on the obtained results for efficiency an for annealing. (C.G.C.).

52254 (KFK–4580) **Acoustic measurements for boiling detection in the KNK II reactor.** Aberle, J. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter. Jun 1989. 67p. (In German). Order Number DE90711760. Available from NTIS (US Sales Only), PC A04/MF A01.

With regard to an integral core surveillance in sodium-cooled breeder reactors acoustic measurement techniques are under development. To determine experimentally the acoustic transfer function of a reactor core and to demonstrate the detectability of local sodium boiling, experiments with a so-called Boiling Generator were carried out in the KNK II reactor. The main part of this Boiling Generator was an electrically heated pin bundle which was equipped with a local blockage to obtain cooling disturbances. The results of the acoustic measurements carried out with the Boiling Generator are presented. Main topic of the evaluation is the determination of the acoustic transfer function between the core and the upper sodium plenum. The signal conditioning necessary prior to this investigation is also explained. Great effort was required to suppress electrical disturbances that superimposed the acoustic signals and which could not be eliminated by the hardware during the experiments. The boiling noise is compared to static and transient

parasitical noise which is to be expected in a reactor. Finally the detectability of local boiling using acoustic measurements is considered. Furthermore the chance to localize the boiling region within the reactor core is discussed on the base of the acoustic boiling signals measured in KNK II. (orig.).

52255 (RTR–2298) **Prototype axial power monitor performance.** Conrad, D.T. Westinghouse Savannah River Co., Aiken, SC (USA). 7 Oct 1985. 55p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. Order Number DE90001314. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

A program to replace the APM detectors and eliminate the TWFM is currently in the prototype evaluation stage. Two types of detectors were evaluated as candidates for replacement of the existing APM detectors: The self-powered flux detector (SPFD) and the self-calibrating gamma thermometer (SCGT). Two prototype APM rods of each design were procured for evaluation. One of each type of prototype APM rod is being irradiated in K and C reactors under TA 1-2191, Irradiate Prototype Axial Power Monitor Rods. This report describes the prototype APM detectors and documents their performance. 3 refs.

52256 (WSRC-RP–89-473) **Applying hypertext to the construction of modular reactor operating procedures.** Krieger, J.W. Westinghouse Savannah River Co., Aiken, SC (USA). [1989]. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-891192–13: Annual Westinghouse computer symposium, Pittsburgh, PA (USA), 6-7 Nov 1989). Order Number DE90000650. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Incomplete or unclear operating procedures have often been cited as a major problem in the nuclear industry. Contributing factors include writers assuming too much knowledge on the part of the operators, and the influence of different writing styles. Over the past few years, interest in computerized procedure systems has been growing steadily. The developers of these systems have faced two problems: first, codifying the existing procedures; and second, keeping the computerized procedures current as the written versions are modified. In this paper, we describe a prototypical system that addresses both the design of procedures and their implementation on computers. The components of the system are a generic user interface and a domain-specific object database. The combination of the two enables the writer to build structured clauses that can be collected to form procedures. For each clause created by the writer, the system creates an equivalent representation in hypertext and code. While the former supports the formatting and display of procedures, the latter enables the writer to test procedures on the objects in the domain database. The overall result is procedures that can be incorporated into a procedure monitoring system without modification. 8 refs., 7 figs.

52257 (WSRC-RP–89-474) **Integrated intelligent systems in advanced reactor control rooms.** Beckmeyer, R.R. Westinghouse Savannah River Co., Aiken, SC (USA). [1989]. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-891192–8: Annual Westinghouse computer symposium, Pittsburgh, PA (USA), 6-7 Nov 1989). Order Number DE89017878. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An intelligent, reactor control room, information system is designed to be an integral part of an advanced control room and will assist the reactor operator's decision making process by continuously monitoring the current plant state and providing recommended operator actions to improve that state. This intelligent system is an integral part of, as well as an extension to, the plant protection and control systems. This paper describes the interaction of several functional components (intelligent information data display, technical specifications monitoring, and dynamic procedures) of the overall system and the artificial intelligence laboratory environment assembled for testing the prototype. 10 refs., 5 figs.

52258 **Applications of artificial intelligence in the U.S. nuclear industry.** Uhring, R.E. (Oak Ridge National Lab., Oak Ridge, TN (US)). pp. 910 of Artificial intelligence and other innovative computer applications in the nuclear industry. Majumdar, M.C.; Majumdar, D.; Sackett, J.I American Nuclear Society, La Grange Park, IL (1987). (CONF-870832–: Topical meeting on artificial intelligence and other innovative computer applications in the nuclear industry: present and future, Snowbird, UT (USA), 31 Aug - 2 sep 1987).

In the United States, the introduction of artificial intelligence (AI) into use in the nuclear power field is being carried out by a wide spectrum of organizations (i.e., nuclear equipment vendors, architect-engineer firms, universities, national laboratories, federal agencies, the electric utility industry, and small entrepreneurial groups). The most coherent of these efforts is an Electric Power Research Institute program to demonstrate the usefulness of AI in nuclear power plants (including augmenting plant automation) and an agreement with NASA to transfer the technology of their multi-year AI Core Technology in Systems Autonomy to the nuclear power industry. A few vendors are offering commercial AI products that reduce the burden on reactor operators during both normal and abnormal operation. Several AI programs at universities and national laboratories have automation as their primary focus, and individual AI projects have been initiated under the Small Business Innovative Research Program. The fundamental and synergistic relationship between training and expert systems supports the use of AI in the training of nuclear personnel.

52259 **Expert robots in nuclear plants.** Byrd, J.S. (E.I. du Pont de Nemours and Co., Savannah River Lab., Aiken, SC (US)); Fisher, J.J.; DeVries, K.R.; Martin, T.P. pp. 910 of Artificial intelligence and other innovative computer applications in the nuclear industry. Majumdar, M.C.; Majumdar, D.; Sackett, J.I American Nuclear Society, La Grange Park, IL (1987). (CONF-870832–: Topical meeting on artificial intelligence and other innovative computer applications in the nuclear industry: present and future, Snowbird, UT (USA), 31 Aug - 2 sep 1987).

Expert robots enhance a safety and operations in nuclear plants. E.I. du Pont de Nemours and Company, Savannah River Laboratory, is developing expert mobile robots for deployment in nuclear applications at the Savannah River Plant. Knowledge-based expert systems are being evaluated to simplify operator control, to assist in navigation and manipulation functions, and to analyze sensory information. Development work using two research vehicles is underway to demonstrate semiautonomous, intelligence, expert robot system operation in process areas. A description of the mechanical equipment, control systems, and operating modes is presented, including the integration of onboard sensors. A control hierarchy that uses modest computational methods is being used to allow mobile robots to autonomously navigate and perform tasks in known environments without the need for large computer systems.

52260 **An expert system for alarm diagnosis and filtering.** Robinson, J.T. (Oak Ridge National Lab., Oak Ridge, TN (US)); Otaduy, P.J. pp. 910 of Artificial intelligence and other innovative computer applications in the nuclear industry. Majumdar, M.C.; Majumdar, D.; Sackett, J.I American Nuclear Society, La Grange Park, IL (1987). (CONF-870832–: Topical meeting on artificial intelligence and other innovative computer applications in the nuclear industry: present and future, Snowbird, UT (USA), 31 Aug - 2 sep 1987).

This paper describes an alarm processing system being developed at the Oak Ridge National Laboratory for implementation in the High Flux Isotope Reactor. The purpose of the system is to perform two related functions, alarm diagnosis and filtering, to aid nuclear plant operators in responding to the large number of alarms typically activated during a major plant transient. The alarm diagnostician determines the root cause of a pattern or sequence of alarms and generates an explanation of the events leading to the alarm sequence. The alarm filter identifies and deemphasize those alarms which are either irrelevant to the current plant condition or contribute no significant new information.

52261 **Smart sensor application to nuclear plant thermocouple channels.** Cannon, N.S. (Westinghouse Hanford Co., Richland, WA (US)); Martin, J.D.; Patterson, B.A.; Stringer, J.L.; Zimmerman, B.D.; Heinisch, H.L.; Cannon, C.P. pp. 910 of Artificial intelligence and other innovative computer applications in the nuclear industry. Majumdar, M.C.; Majumdar, D.; Sackett, J.I American Nuclear Society, La Grange Park, IL (1987). (CONF-870832–: Topical meeting on artificial intelligence and other innovative computer applications in the nuclear industry: present and future, Snowbird, UT (USA), 31 Aug - 2 sep 1987).

The application of smart sensor technology to thermocouple (TC) channels at the Fast Flux Test Facility (FFTF) has been accomplished. The objective of this work was to provide a first step toward the development of nuclear plant sensor systems that not only produce a transducer output signal, but also perform diagnostics on the sensor channel to provide signal validation. When TC impairment was detected, the system provided an analysis of the severity of the damage, its location, and probable cause. Two systems were constructed: a laboratory system for development purposes, and a follow-on system for installation at FFTF. Since its installation, the FFTF system continues to provide TC trending data for lifetime predictions, and a test facility for new concepts. The laboratory system has been adapted to include a new sensor type, an FFTF low-level neutron flux monitor.

52262 **An expert system for sensor data validation and malfunction detection.** Hashemi, S. (IntelliCorp, Mountain View, CA (US)); Hajek, B.K.; Miller, D.W. pp. 910 of Artificial intelligence and other innovative computer applications in the nuclear industry. Majumdar, M.C.; Majumdar, D.; Sackett, J.I American Nuclear Society, La Grange Park, IL (1987). (CONF-870832–: Topical meeting on artificial intelligence and other innovative computer applications in the nuclear industry: present and future, Snowbird, UT (USA), 31 Aug - 2 sep 1987).

Nuclear power plant operation and monitoring in general is a complex task which requires a large number of sensors, alarms and displays. At any instant in time, the operator is required to make a judgment about the state of the plant and to react accordingly. During abnormal situations, operators are further burdened with time constraints. The possibility of an undetected faulty instrumentation line, adds to the complexity of operators' reasoning tasks. Recent work at The Ohio State University Laboratory of Artificial Intelligence Research (LAIR) and the nuclear engineering program has concentrated on the problem of diagnostic expert systems performance and their applicability to the nuclear power plant domain. The authors have also been concerned about the diagnostic expert systems performance when using potentially invalid sensor data. Because of this research, they have developed an expert system that can perform diagnostic problem solving despite the existence of some conflicting data in the domain. This work has resulted in enhancement of a programming tool, CSRL, that allows domain experts to create a diagnostic system that will be to some degree, tolerant of bad data while performing diagnosis. This expert system is described here.

52263 **The DISYS real-time diagnostics/control system and its application to the EBR II.** Christie, A.M. (Westinghouse Electric Corp., Monroeville, PA (US)); Lindsay, R.W. pp. 910 of Artificial intelligence and other innovative computer applications in the nuclear industry. Majumdar, M.C.; Majumdar, D.; Sackett, J.I American Nuclear Society, La Grange Park, IL (1987). (CONF-870832–: Topical meeting on artificial intelligence and other innovative computer applications in the nuclear industry: present and future, Snowbird, UT (USA), 31 Aug - 2 sep 1987).

DISYS is a real-time diagnostic and control guidance expert system designed to aid plant operators during off-normal events. Currently it is being implemented and tested at the Experimental Breeder Reactor II. DISYS is driven by sensor input and evaluates symptoms and faults associated with components. Component faults in turn allow an evaluation of sub-system, system and plant faults. The hierarchical model of the plant as used by DISYS also allows information regarding system reconfiguration to be generated in the event of a fault. Current testing at EBR II indicates that DISYS can successfully detect component and system anomalies. A model of the Argon Cooling System has been constructed and currently has about 300 rules. Once the diagnosis system for the ACS has been completed, it is intended to implement DISYS on other reactor systems.

52264 **Update on the USNRC's nuclear plant analyzer.** Laats, E.T. (Idaho National Engineering Lab., EG and G Idaho, Inc., Idaho Falls, ID (US)). pp. 1021 of Proceedings of the 1987 summer computer simulation conference. Chou, J.Q.B Society for Computer Simulation, San Diego, CA (1987). (CONF-870706–: 19. annual summer computer simulation conference, Montreal (Canada), 27-30 Jul 1987).

The Nuclear Plant Analyzer (NPA) is the U.S. Nuclear Regulatory Commission's (NRC's) state-of-the-art nuclear reactor simulation capability. This computer software package integrates high fidelity nuclear reactor simulation codes such as the TRAC and RELAPS series of codes with color graphics display techniques and advanced workstation hardware. An overview of this program was given at the 1984 Summer Computer Simulation Conference (SCSC), with selected topics discussed at the 1985 and 1986 SCSCs. This paper addresses these activities and related experiences. First, The Class VI computer implementation is discussed. The trade-offs between gaining significantly greater computational speed and central memory, with the loss of performance due to many more simultaneous users is shown. Second, the goal of the super-minicomputer implementation is to produce a very cost-effective system that utilizes advanced (multi-dimensional, two-phase coolant) simulation capabilities at real wall-clock simulation times. Benchmarking of the initial super-minicomputer implementation is discussed. Finally, the technical and economic feasibility is addressed for implementing the super-minicomputer version of the NPA with the RELAPS simulation code onto the Black Fox full scope nuclear power plant simulator.

52265 **Tightly coupled transient analysis of EBR-II.** Makowitz, H. (Idaho National Engineering Lab., (INEL) (US)); Lehto, W.K.; Sackett, J.I. vp of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y American Society of Mechanical Engineers, New York, NY (1988). (CONF-880702–: 23. intersociety energy conversion engineering conference, Denver, CO (USA), 31 Jul - 5 aug 1988).

Technical Paper 889073.

A Tightly Coupled transient analysis system for the Experimental Breeder Reactor-II (EBR-II) is currently being tested. The system consists of a faster than real time high fidelity reactor simulation, advanced graphics displays, expert system coupling, and real time data coupling via the EBR-II data acquisition system to and from the plant and the control system. The base, first generation software has been developed and is presently being tested. Various subsystem couplings and the total system integration are being checked out. This system should enhance the diagnostic and prognostic capability of EBR-II in the near term and provide automatic control during startup and power maneuvering in the future, as well as serve as a testbed for new control system development for advanced reactors.

52266 **Using an integration development methodology to produce a reactor control system for the advanced test reactor at the INEL (Idaho National Engineering Laboratory).** Smith, R.L. (EG and G Idaho, Inc., Idaho Falls, ID (US)); Svoboda, J.M. pp. 910 of Artificial intelligence and other innovative computer applications in the nuclear industry. Majumdar, M.C.; Majumdar, D.; Sackett, J.I American Nuclear Society, La Grange Park, IL (1987). (CONF-870832–: Topical meeting on artificial intelligence and other innovative computer applications in the nuclear industry: present and future, Snowbird, UT (USA), 31 Aug - 2 sep 1987).

A new design methodology is being used at the INEL to produce a distributed reactor console display system and a simulator for the ATR. The methodology integrates off-the-shelf software and hardware components into turnkey custom systems that meet the specific needs of the ATR. The objective of the methodology is to deliver usable systems quickly and at very low relative costs.

52267 **Structure of controllers for the direct digital control of reactor power.** Bernard, J.A. (MIT Nuclear Reactor Lab., Massachusetts Institute of Technology, Cambridge, MA (US)). pp. 910 of Artificial intelligence and other innovative computer applications in the nuclear industry. Majumdar, M.C.; Majumdar, D.; Sackett, J.I American Hospital Assoc., Chicago, IL (1987). (CONF-870832–: Topical meeting on artificial intelligence and other innovative computer applications in the nuclear industry: present and future, Snowbird, UT (USA), 31 Aug - 2 sep 1987).

The structure of controllers for the direct digital control of power in a nuclear reactor is examined and features possibly important to licensing are identified. This was done by first reviewing the human approach to process control and then discussing designs whereby digital systems could be made to emulate each of the functions that a human operator now performs. Features identified as relevant to licensing include the separation of the safety and control systems, the use of supervisory algorithms that incorporate the concept of

feasibility of control, signal validation, verification of signal implementation, and the use of either fault-tolerant or redundant hardware. Examples supporting the above findings are drawn from the MIT experience in first designing and then licensing a digital, closed-loop controller for the 5 MWt MIT Research Reactor.

52268 **Promises in intelligent plant control systems.** Otaduy, P.J. (Oak Ridge National Lab., Oak Ridge, TN (US)). pp. 910 of Artificial intelligence and other innovative computer applications in the nuclear industry. Majumdar, M.C.; Majumdar, D.; Sackett, J.I American Nuclear Society, La Grange Park, IL (1987). (CONF-870832–: Topical meeting on artificial intelligence and other innovative computer applications in the nuclear industry: present and future, Snowbird, UT (USA), 31 Aug - 2 sep 1987).

The control system is the brain of a power plant. The traditional goal of control systems has been productivity. However, in nuclear power plants the potential for disaster requires safety to be the dominant concern, and the worldwide political climate demands trustworthiness for nuclear power plants. To keep nuclear generation as a viable option for power in the future, trust is the essential critical goal which encompasses all others. In most of today's nuclear plants the control system is a hybrid of analog, digital, and human components that focuses on productivity and operates under the protective umbrella of an independent engineered safety system. Operation of the plant is complex, and frequent challenges to the safety system occur which impact on their trustworthiness. Advances in nuclear reactor design, computer sciences, and control theory, and in related technological areas such as electronics and communications as well as in data storage, retrieval, display, and analysis have opened a promise for control systems with more acceptable human brain-like capabilities to pursue the required goals. This paper elaborates on the promise of futuristic nuclear power plants with intelligent control systems and addresses design requirements and implementation approaches.

52269 **Macroscopic mass and energy balance for nuclear plant diagnostics using fuzzy logic.** Hassberger, J.A. (Dept. of Nuclear Engineering, Univ. of Michigan, Ann Arbor, MI (US)); Lee, J.C. pp. 910 of Artificial intelligence and other innovative computer applications in the nuclear industry. Majumdar, M.C.; Majumdar, D.; Sackett, J.I American Nuclear Society, La Grange Park, IL (1987). (CONF-870832–: Topical meeting on artificial intelligence and other innovative computer applications in the nuclear industry: present and future, Snowbird, UT (USA), 31 Aug - 2 sep 1987).

This paper presents a method for computer-assisted nuclear power plant failure diagnostics. The method is based on the analysis of macroscopic mass and energy balances in thermal hydraulic control volumes using fuzzy logic. The method is intended to provide assistance to operators during unanticipated transient conditions.

52270 **The use of PROLOG for computerized Technical Specifications.** Lidsky, L.M. (Dept. of Nuclear Engineering, The Massachusetts Institute of Technology, Cambridge, MA (US)); Lanning, D.D.; Dobrzeniecki, A.B.; Meyers, K.; Reese, T.G. pp. 910 of Artificial intelligence and other innovative computer applications in the nuclear industry. Majumdar, M.C.; Majumdar, D.; Sackett, J.I American Nuclear Society, La Grange Park, IL (1987). (CONF-870832–: Topical meeting on artificial intelligence and other innovative computer applications in the nuclear industry: present and future, Snowbird, UT (USA), 31 Aug - 2 sep 1987).

The task of deciding whether a particular nuclear plant condition is in compliance with its Technical Specifications is, in principle, algorithmic. However, the implicit algorithm is so complex and the required level of confidence in code validity is so high that traditional methods of computerized analysis have proven unsatisfactory. PROLOG provides a close match to the explicit semantic structure of the written specifications, a good tool for analysis of the implicit subsystem operability trees and, by virtue of its declarative style and imbedded logical structure, greatly simplifies the problem of code validation. LCOM, a PROLOG representation of a subset of BWR Technical Specifications, was developed to explore the applicability of PROLOG in this problem domain and to provide benchmark data for full-scale implementations. The declarative style and built-in unification mechanism of PROLOG does substantially simplify the process of program construction and validation. Extrapolations indicate processing times for a complete Tech Spec implementation of $\leq$ 1 minute in systems capable of $\geq$ 20 KLIPS.

52271 **An expert system for spare parts inventory control.** Kim, K.Y. (Univ. of California, Los Angeles, CA (US)); Chen, P.Y.C.; Okrent, D. pp. 910 of Artificial intelligence and other innovative computer applications in the nuclear industry. Majumdar, M.C.; Majumdar, D.; Sackett, J.I American Nuclear Society, La Grange Park, IL (1987). (CONF-870832–: Topical meeting on artificial intelligence and other innovative computer applications in the nuclear industry: present and future, Snowbird, UT (USA), 31 Aug - 2 sep 1987).

This paper describes an expert system which can handle spare part requirements not only in corrective maintenance (CM) or preventive maintenance (PM), but also when failure rates of components or parts are updated by new data or by predictive maintenance (PDM), and which can also decide optimum stocking level of each spare part. This expert system provides a maintenance (or inventory) manager with an improved basis for decision making in the maintenance related to spare parts. The definitions of PM and PDM from NUREG-1212 (USNRC 1986) are used herein. This expert system used Intellignece/Compiler (Intelligence Ware, 1986) as a language/tool in the IBM-PC.

52272 **The development of an expert system for finding fragility curves of building structural systems in the preliminary design stage.** Yee, L.Y. (Mechanical, Aerospace and Nuclear Engineering Dept., Univ. of California, Los Angeles, CA (US)); Okrent, D. pp. 910 of Artificial intelligence and other innovative computer applications in the nuclear industry. Majumdar, M.C.; Majumdar, D.; Sackett, J.I American Nuclear Society, La Grange Park, IL (1987). (CONF-870832–: Topical meeting on artificial intelligence and other innovative computer applications in the nuclear industry: present and future, Snowbird, UT (USA), 31 Aug - 2 sep 1987).

This research is a starting point for the development of an expert system for determining seismic fragility curves of structural systems in a nuclear power plant or conventional building at the preliminary design stage. The resulting system assists an engineer with moderate engineering background and limited reliability knowledge to analyze the failure functions of building structures. It simulates the performance of an expert in identifying the potential failure modes and their variabilities for a structure of interest. On reviewing the methodology of seismic fragility evaluation for existing building structures in the nuclear power plant industry, one finds that the investigation process starts with the identification of critical components or substructures, whose failures result in the functional failure of safety related equipment or the failure of structural integrity itself, and follows with complicated numerical analyses to estimate the capacity functions associated with the limit states of these components or substructures.

52273 **Advanced technology for nuclear powerplants.** Rohm, H.H. (Office of Nuclear Energy, U.S. Dept. of Energy, Washington, DC (US)). pp. 910 of Artificial intelligence and other innovative computer applications in the nuclear industry. Majumdar, M.C.; Majumdar, D.; Sackett, J.I American Nuclear Society, La Grange Park, IL (1987). (CONF-870832–: Topical meeting on artificial intelligence and other innovative computer applications in the nuclear industry: present and future, Snowbird, UT (USA), 31 Aug - 2 sep 1987).

Advanced technology offers significant potential benefit to the nuclear industry. Improvements can be anticipated in plant performance, reliability, and overall plant safety as well as reduced life cycle costs. Utilizing artificial intelligence and expert systems, robotics, advanced instruments and controls, and modularization technologies can enhance plant operations and provide new insights and perspectives to plant risk and thus focus resources to areas of importance. Plant reliability, operability, availability, accident interdiction and limitation, and plant recovery are expected to improve. However, utilizing these technologies is not an automatic process. In addition to the actual costs associated with developing and implementing the technologies, operator training and acceptance represents a potential significant problem. Traditional plant operators have little or no experience with computer technology. There has already been some difficulty getting nuclear plant operators to accept and use the new technologies that have been

implemented to accept and use the new technologies that have been implemented thus far.

52274 **Heuristic simulation of nuclear systems on a supercomputer using the HAL-1987 general-purpose production-rule analysis system.** Ragheb, M. (Univ. of Illinois, Urbana, IL (US)); Gvillo, D.; Makowitz, H. pp. 910 of Artificial intelligence and other innovative computer applications in the nuclear industry. Majumdar, M.C.; Majumdar, D.; Sackett, J.I American Nuclear Society, La Grange Park, IL (1987). (CONF-870832–: Topical meeting on artificial intelligence and other innovative computer applications in the nuclear industry: present and future, Snowbird, UT (USA), 31 Aug - 2 sep 1987).

HAL-1987 is a general-purpose tool for the construction of production-rule analysis systems. It uses the rule-based paradigm from the part of artificial intelligence concerned with knowledge engineering. It uses backward-chaining and forward-chaining in an antecedent-consequent logic, and is programmed in Portable Standard Lisp (PSL). The inference engine is flexible and accommodates general additions and modifications to the knowledge base. The system is used in coupled symbolic-procedural programming adaptive methodologies for stochastic simulations. In Monte Carlo simulations of particle transport, the system considers the pre-processing of the input data to the simulation and adaptively controls the variance reduction process as the simulation progresses. This is accomplished through the use of a knowledge base of rules which encompass the user's expertise in the variance reduction process. It is also applied to the construction of model-based systems for monitoring, fault-diagnosis and crisis-alert in engineering devices, particularly in the field of nuclear reactor safety analysis.

52275 **The use of automation with the new pneumatic irradiation facility of the ORNL HFIR.** Dyer, F.F. (Oak Ridge National Lab., TN (USA)); Robinson, L.; Emery, J.F. *Transactions of the American Nuclear Society (USA)*, 56: 194 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The High Flux Isotope Reactor at Oak Ridge National Laboratory has two pneumatic irradiation systems: PT-1 installed in 1970 and PT-2 installed in 1987, which are used for neutron activation analysis. Both systems have been described in the literature. By means of a Gould programmable controller, considerable progress has been made in a cost-effective manner to operate and automate the features of the new facility. A neutron counter is an integral part of the new pneumatic tube, and all of the hardware is present to enable automated delayed neutron counting. Some automation of the old system has also been accomplished by the use of a Zymark general purpose programmable robot. This paper describes the automated features of both systems. The reactor has been shut down for safety evaluation since November 1986, so that no irradiations have been made in the new pneumatic tube.

2205 Environmental Aspects

Refer also to citation(s) 51802, 51862, 51877, 52235, 52294, 52297, 52332, 53231, 53877

52276 (DP–1766-Rev.1) **Compliance of the Savannah River Plant L-Reactor cooling system with environmental regulations: Demonstration in accordance with Section 316(a) of the Clean Water Act, November 1985–December 1987: Revision 1.** Gladden, J.B.; Specht, W.L.; Bowers, J.A.; Halverson, N.V.; Mackey, H.E.; Wilde, E.W. (eds.). Savannah River Lab., Aiken, SC (USA). Jun 1989. 722p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-76SR00001. Order Number DE89017822. Available from NTIS, PC A99/MF A01 - OSTI; GPO Dep.

This document presents information relating to demonstration under Section 316(a) of the Clean Water Act for the L-Reactor cooling system at the Savannah River Plant (SRP). The demonstrations were mandated when the National Pollution Discharge Elimination System (NPDES) permit for SRP (SC0000175) was amended in 1984 to include the thermal discharge from L-Reactor outfall (L-007). L Reactor operated from 1954 to 1968, when it was placed in stand-by condition. In 1980 President Carter signed the Nuclear Stockpile Memorandum that mandated that the Department of Energy (DOE) increase production of plutonium for US weapons programs. DOE identified the restart of the L Reactor at SRP as the preferred alternative for achieving increased production and selected the construction of a 1000-acre, once-through cooling reservoir (L Lake) on Steel Creek to mitigate the effects of the thermal discharge. Dam construct and the filling of L Lake was completed in October 1985, before L Reactor resumed operations. The NPDES specifications for L Reactor mandated that biological studies be conducted in L Lake to confirm that a balanced biological community (BBC) would develop in the lower 50% of the lake. Biological studies were also required for Steel Creek because exit temperatures from the lake were predicted to periodically exceed 2.8°C (5°F) above seasonal ambient temperatures. The NPDES permit required that the results of these studies be submitted to the South Carolina Department of Health and Environmental Control (SCDHEC) no later than 6 months prior to the expiration of the current permit in December 1988. 300 refs., 150 figs., 120 tabs.

52277 (LALP–89-14) **A memorial colloquium honoring Herbert L. Anderson.** Nagle, D.E. Los Alamos National Lab., NM (USA). Aug 1989. 32p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. Order Number DE90001210. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper is the result of a colloquium honoring Herbert Anderson. The paper contains memorial statements to the late Mr. Anderson and reports on; chemical analysis of the 1988 Soviet mission to Mars, Mammalian cell genetic regulation and the nature of cancer, and clean atmosphere and nuclear reactors. (JEF)

52278 (NUREG–0837-Vol.9-No.2) **NRC [Nuclear Regulatory Commission] TLD [thermoluminescent dosimeter] direct radiation monitoring network: Progress report, April–June 1989.** Struckmeyer, R.; McNamara, N. Nuclear Regulatory Commission, King of Prussia, PA (USA). Region I. Sep 1989. 226p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A11/MF A01 - GPO; OSTI; INIS.

This report provides the status and results of the NRC Thermoluminescent Dosimeter (TLD) Direct Radiation Monitoring Network. It presents the radiation levels measured in the vicinity of NRC licensed facility sites throughout the country for the second quarter of 1989.

52279 (NUREG/CR–4949) **Source term calculations for assessing radiation dose to equipment.** Denning, R.S.; Freeman-Kelly, R.; Cybulskis, P.; Curtis, L.A. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Battelle Columbus Div., OH (USA). Jul 1989. 63p. Sponsored by Nuclear Regulatory Commission. (BMI–2153). Available from NTIS, PC A04/MF A01 - GPO; OSTI; INIS.

Includes 2 sheets of microfiche supplements.

This study examines results of analyses performed with the Source Term Code Package to develop updated source terms using NUREG-0956 methods. The updated source terms are to be used to assess the adequacy of current regulatory source terms used as the basis for equipment qualification. Time-dependent locational distributions of radionuclides within a containment following a severe accident have been developed. The Surry reactor has been selected in this study as representative of PWR containment designs. Similarly, the Peach Bottom reactor has been used to examine radionuclide distributions in boiling water reactors. The time-dependent inventory of each key radionuclide is provided in terms of its activity in curies. The data are to be used by Sandia National Laboratories to perform shielding analyses to estimate radiation dose to equipment in each containment design. See NUREG/CR-5175, "Beta and Gamma Dose Calculations for PWR and BWR Containments." 6 refs., 11 tabs.

52280 (NUREG/CR–5247) **RASCAL [Radiological Assessment System for Consequence Analysis] Version 1.3 user's guide.** Athey, G.F.; Sjoreen, A.L.; McKenna, T.J. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Operational Assessment; Oak Ridge National Lab., TN (USA). Sep 1989. 165p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. (ORNL/TM–10955). Available from NTIS, PC A08/MF A01 - GPO; OSTI; INIS.

A new dose assessment system, RASCAL, has been developed for the US Nuclear Regulatory Commission (NRC) for use during response to emergencies. The model is designed to provide a rough comparison with EPA Protective Action Guidance and thresholds for acute health effects. RASCAL will be used by the NRC personnel who report to the site of a nuclear accident to conduct an independent evaluation of dose and consequence projections. The model was developed to allow consideration of the dominant aspects of source term, transport, dose, and consequences. The model graphics were designed for use on the COMPAQ Portable III microcomputer used by the NRC response personnel who respond to the emergency. However, the model can be run on any DOS system. The model results can be displayed as text or in graphical form. The development of the model is ongoing. Subsequent versions are planned to: (1) allow the previous cases to be stored, (2) include fuel cycle facilities and containment monitor readings in the source term methods, (3) include terrain and building wake in the transport and diffusion methods, and (4) estimate exposure rates. 26 refs., 13 figs., 15 tabs.

52281 (WSRC-RP–89-397) **Development of aqueous tritium effluent monitor.** Hofstetter, K.J. Westinghouse Savannah River Co., Aiken, SC (USA). 1989. 18p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-891082–2: International conference on new trends in liquid scintillation counting and organic scintillators, Gatlinburg, TN (USA), 2-5 Oct 1989). Order Number DE90001308. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A variety of techniques have been evaluated and tested in an attempt to develop a monitor for tritium at low-levels in aqueous streams. One system tested was commercially available, HPLC radioactivity monitor. This system uses crushed yttrium silicate as the scintillator and employs standard fast coincidence electronics to measure tritium in a flowing stream. Laboratory tests of this unit indicate that the monitor can sense tritium at concentrations above 600 pCi/cc using a two (2) minute counting interval. Pooling the count rate data over a longer interval, (e.g.,. 24 hours) results in a detection limit of ~20 pCi/cc, under constant background conditions. Unfortunately, the cells are easily plugged with debris even under laboratory conditions. To overcome this problem, a prototype system was designed, fabricated, and is being tested in the laboratory. The prototype used unclad fibers of plastic scintillator as the detection medium. Approximately 500 1mm-diam fibers were assembled into a flow cell with two 51mm-diam photomultipliers (PMTs) coupled to the ends of the fiber bundles to detect the scintillations. Fast coincidence, pulse shaping electronics are used to minimize the single photon and dark current backgrounds. The tritium counting efficiency, background, and sensitivity will be determined in the laboratory followed by field reliability testing. 10 refs., 4 figs., 4 tabs.

52282 **Human engineering considerations in the design of New Virginia Power Radwaste facilities.** Bankley, A.V.; Morris, L.L.; Lippard, D.W. *Transactions of the American Nuclear Society (USA),* 56: 82-83 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Human engineering principles were considered by Virginia Power in the recent design of new radwaste facilities (NRFs) for both the Surry and North Anna power stations. Virginia Power recognized that the rigorous application of human engineering principles to the NRF design was essential to the ultimate success or failure of the facilities. Success of the NRF should not only be measured in the volume of radwaste processed but also by other factors such as (a) availability and maintainability of preferred equipment, (b) as-low-as-reasonably-achievable considerations, (c) actual release rates versus achievable release rates, and (d) flexibility to deal with varying circumstances. Each of these success criteria would suffer as the result of operator/human inefficiencies or error. Therefore, human engineering should be applied to the maximum practical extent to minimize such inefficiencies or errors. No method is ever going to ensure a perfectly human-engineered facility design. Virginia Power believes, however, that significant strides have been made in efforts to design and construct a successful radwaste processing facility, a facility where operating success rests with the ability of the human operators to perform their jobs in an efficient and reliable fashion.

52283 **Human engineering in mobile radwaste systems.** Jones, D.; McMahon, J.; Motl, G. *Transactions of the American Nuclear Society (USA),* 56: 83 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

To a large degree, mobile radwaste systems are replacing installed plant systems at US nuclear plants due to regulatory obsolescence, high capital and maintenance costs, and increased radiation exposure. Well over half the power plants in the United States now use some sort of mobile system similar to those offered by LN Technologies Corporation. Human engineering is reflected in mobile radwaste system design due to concerns about safety, efficiency, and cost. The radwaste services business is so competitive that vendors must reflect human engineering in several areas of equipment design in order to compete. The paper discusses radiation exposure control, contamination control, compact components, maintainability, operation, and transportability.

2206 Research, Test, and Experimental Reactors

Refer also to citation(s) 52027, 52261, 52263, 52266, 52267, 52293, 52294, 52325, 52649, 52737, 52937, 53676, 53862

52284 (CONF-8811203–) **Report of the advanced neutron source (ANS) aluminum cladding corrosion workshop.** Hanson, G.H.; Gibson, G.W.; Griess, J.C.; Pawel, R.E.; Pace, N.E.; Ryskamp, J.M. Oak Ridge National Lab., TN (USA). Feb 1989. 44p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From American Nuclear Society (ANS) aluminium cladding corrosion workshop; Idaho Falls, ID (USA); 16-17 Nov 1988. Order Number DE90001281. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The Advanced Neutron Source (ANS) Corrosion Workshop on aluminum cladding corrosion in reactor environments is summarized. The Workshop was held to examine the aluminum cladding oxidation studies being conducted in support of the ANS design. This report was written principally to provide a record of the ideas and judgments expressed by the workshop attendees. The ANS operating heat flux is significantly higher than that in existing reactors, and early experiments indicate that there may be an aluminum cladding oxidation problem unique to higher heat fluxes or associated cladding temperatures that, if not solved, may limit the operation of the ANS to unacceptably low power levels. A brief description of the information presented by each speaker is included along with a compilation of the most significant ideas and recommended research areas. The appendixes contain a copy of the workshop agenda and a list of attendees.

52285 (GKSS–89/E/12) **Examinations of the irradiation behaviour of U_3Si_2 test fuel plates with low enrichment.** Muellauer, J. GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). 1989. 29p. (In German). Order Number DE90711708. Available from NTIS (US Sales Only), PC A03/MF A01.

Five low-enriched (19.7% ^{235}U), high-density (4.7 gU/cm^3) U_3Si_2-test fuel plates (miniplates) with different fine grain contents have been qualified under irradiation. During the course of irradiation up to burnup of 63% ^{235}U depletion, no released fractions of gaseous or solid fission products from the fuel plate to the rig coolant were detected. The measured swelling rate of the fuel zone (meat) is less than 0.45% $\Delta V/10^{20}$ fissions/cm^3 the blister-threshold temperature of the fuel plates is above 520^{0}C. The favourable irradiation behavior of the U_3Si_2 fuel plates was not influenced by using higher amounts of fine grained particles (40%<40 μm grain size). (orig.) With 11 figs., 4 tabs.

52286 (JAERI-M–89-049) **Evaluation of core inlet coolant temperature of HTTR.** Fujimoto, Nozomu; Maruyama, Soh; Sudo, Yukio. Japan Atomic Energy Research Inst., Tokyo (Japan). May 1989. 56p. (In Japanese). Order Number DE90710038. Available from NTIS (US Sales Only), PC A04/MF A01.

The Japan Atomic Energy Research Institute (JAERI) has been planning the construction of High Temperature Engineering Test Reactor (HTTR) which in 30MW in thermal power, 850degC and 950degC in outlet coolant temperature and 40kg/cm^2G in primary

coolant pressure. In the HTTR, coolant flows upward in channels between core and Reactor Pressure Vessel (RPV), then mixed in the upper plenum and flows into the core. This report presents the evaluation results of the core inlet temperature, which is a fundamental value of maximum fuel temperature calculation. Temperature behavior at the core side channel is calculated by FEM code and temperature mixing characteristics is calculated by thermal-hydraulic code 'STREAM'. The evaluation error of core inlet temperature is one of the hot spot factors for the maximum fuel temperature calculation. (author).

52287 (Juel-Spez–478) **Thermohydraulic analyses concerning the failure of forced convection in a water-cooled research reactor. A contribution to the modernisation of a Juelich research reactor.** Meister, G. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Sicherheitsforschung. Dec 1988. 32p. (In German). Order Number DE90711186. Available from NTIS (US Sales Only), PC A03/MF A01.

For the planned research reactor MJF, the discharge of the afterheat by natural convection is analyzed. The investigation comprises three different cycle variants. The analyses were carried out by means of the SIKAN calculation program, which simulates the dynamics of a two-phase flow in a cycle. (orig.).

52288 (WHC-SA–0368) **Low temperature irradiations in FFTF [Fast Flux Test Facility].** Grover, J.M.; Bauer, R.E.; Puigh, R.J.; Thielges, J.R. Westinghouse Hanford Co., Richland, WA (USA). Sep 1988. 7p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-87RL10930. (CONF-881031–72: 8. topical meeting on technology of fusion energy, Salt Lake City, UT (USA), 9-13 Oct 1988). Order Number DE90001219. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The fusion materials program has little irradiation effects data at temperatures from 100 to 350 °C. Near-term machines such as the International Thermonuclear Engineering Reactor (ITER) will expose materials to neutron doses of 38 to 50 dpa at 150 °C or less. The data base for structural materials must be extended into this range. Also, lower temperatures are needed to investigate the lower bound for tritium release from solid breeder materials. A low temperature test vehicle is proposed for the Fast Flux Test Facility (FFTF), which will provide test temperatures of 100 to 350 °C. An 8.5-cm dia. by 100-cm test volume will be instrumented to collect temperature data and provide feedback for control. The spectrum and flux will provide accelerated damage accumulation for structural materials testing and the best available approximation of fusion reactor conditions for solid breeder materials testing. Breeder samples can be equipped with sweep gas flow lines for tritium recovery tests. 4 refs., 2 figs., 1 tab.

2207 Plutonium and Isotope Production Reactors

Refer also to citation(s) 51743, 51952, 51953, 51973, 51988, 52257, 52260, 52275, 52276

52289 (DP-MS–88-242) **Plant community structure in disturbed and undisturbed forested wetlands.** Firth, P.L.; Hooker, K.L. Westinghouse Savannah River Co., Aiken, SC (USA). [1989]. 14p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-8909208–1: American Water Resources Association conference, Tampa, FL (USA), 17-22 Sep 1989). Order Number DE90000657. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This study documented the floodplain plant communities at three disturbed and three undisturbed sites during a two year period. The study took place at the Savannah River Plant in the South Carolina coastal plain. The disturbed sites were stressed by heated effluents, flooding, and siltation. Taxa richness differed little between the six sites, but the undisturbed sites had relatively more tree and vine taxa while the disturbed sites had relatively more shrub and herb taxa. Community similarity comparison indicated that disturbance continued to impact and change plant assemblages during this study. Herbaceous cover and dominant herb taxa changed between years at all sites, primarily in response to soil saturation and the timing, extent and duration of inundation. The disturbed sites had communities of dense, small wetland successional trees. The undisturbed sites had either cypress-red maple or bottomland hardwood tree communities. Large numbers of trees died at the disturbed sites during this study (up to >27% net loss). The greatest losses were experienced by wax myrtle (Myrica), willow (Salix), and alder (Alnus). With the plant community structure rapidly shifting at the disturbed sites, it is very likely that the beneficial functions of the floodplain wetlands in the Steel Creek corridor were adversely impacted. 18 refs., 4 figs., 12 tabs.

2208 Propulsion Reactors

Refer also to citation(s) 52297

2209 Reactor Safety

Refer also to citation(s) 51753, 51758, 52228, 52255, 52262, 52267, 52278, 52279, 52280, 52395, 52620, 52711, 52857, 52872, 53232, 53233, 53234, 53235, 53236, 53286, 53432, 53433, 53434, 53435, 53436, 53438, 53439, 54046

52290 **Hydrogen combustion experiments in a 1/4-scale model of a nuclear power plant containment.** Tamanini, F. (Factory Mutual Research Corporation, Norwood, MA (USA)); Ural, E.A.; Chaffee, J.L.; Hosler, J.F. pp. 2072 of Twenty-second symposium (international) on combustion. The Combustion Institute, Pittsburgh, PA (1989). From 22. international symposium on combustion; Seattle, WA (USA); 14-19 Aug 1988.

Hydrogen combustion experiments were carried out to evaluate the performance of a hydrogen mitigation system based on the controlled combustion concept. Hydrogen burning was initiated by a distributed ignition system using glow plug igniters. The objective of the study was to obtain data on the combustion phenomenology and on the thermal environment produced by the burning of hydrogen as might occur during a recoverable degraded core accident. The thermal environment was characterized through measurements of three quantities: gas temperatures, gas velocities, and radiant heat fluxes. Several highly-instrumented tests were performed in the test facility with the internal geometry adjusted so as to reproduce four possible plant configurations. Following a preassigned release history, hydrogen was introduced at the bottom of the test volume through spargers and vent holes located below the surface of a body of water modeling the suppression pool existing in the plants. Two hydrogen injection histories were used during these tests, simulating two different accident recovery scenarios. The dominant combustion mode observed during the tests involved diffusion flames anchored at the surface of the pool. Other types of combustion, involving lifted-diffusion flames and localized burning, were observed at low-oxygen conditions and low hydrogen injection rates, respectively. Other than mild localized initial lightoff burns, deflagrations did not occur in the tests. For oxygen concentrations down to 8%, the distributed ignition system was successful at maintaining the background hydrogen concentration below 4.5-5% by volume.

52291 (CONF-8904156–31) **The development of trend and pattern analysis methods for incident data by CEC's Joint Research Centre at Ispra (Italy).** Amesz, J.; Kalfsbeek, H.W. Nuclear Energy Agency, 75 - Paris (France). Committee on the Safety of Nuclear Installations; Commission of the European Communities, Brussels (Belgium). Apr 1989. 34p. From CSNI-CEC specialist meeting on trends and pattern analyses of operational data from nuclear power plants; Rome (Italy); 3-7 Apr 1989. Order Number DE89793181. Available from NTIS (US Sales Only), PC A03/MF A01.

This paper gives an overview of the development of trend and pattern analysis techniques of the Abnormal Occurrences Reporting System (AORS) of the Commission of the European Communities (CEC). The event sequence analysis tool exploits the notion that any nuclear power plant incident can be decomposed into a sequence of interrelated steps or occurrences, which give the cause-consequence paths or nets. By searching the data for predefined (fuzzy) patterns of occurrences, underlying mechanisms of relevant incident mechanisms might be revealed. Statistical methods involve the following: - time between event analysis: tracing cyclic or trend behavior of specific classes of events; - binary set

comparison: contrasting the relative reporting frequencies of all format items (including keywords) within two disjunct sets of reports; - plant operating profiles: determination of significant deviations of frequency of reporting for a given plant as compared to a population of similar plants; - multidimensional contingency table analysis: determination of multiple dependencies between incident descriptors and of significant multiple interactions between incident parameter values. For all the above mentioned methods, some illustrative examples of application to the AORS data will be presented.

52292 (CONF-8904156–37) **The Significant Event Compilation Tree - SECT: Theory and application.** Ishack, G.A.; Ragheb, H. Nuclear Energy Agency, 75 - Paris (France). Committee on the Safety of Nuclear Installations; Commission of the European Communities, Brussels (Belgium). Apr 1989. 20p. From CSNI-CEC specialist meeting on trends and pattern analyses of operational data from nuclear power plants; Rome (Italy); 3-7 Apr 1989. Order Number DE89793188. Available from NTIS (US Sales Only), PC A03/MF A01.

The Significant Event Compilation Tree (SECT) is a computer programme that was developed by staff of the Canadian Atomic Energy Control Board during the period 1984-86. Its primary purpose is to link seemingly unrelated events, or parts of events, that could have occurred at different points in time at various nuclear power plants. Using such a software tool aids in the identification of potential paths and/or scenarios that: may not have been foreseen in the accident analysis (including fault tree verification); could lead to a certain failure; or could have been caused by a certain initiating event (which may have ended or been terminated at an earlier stage). This paper describes: the basic idea of SECT; the criteria whereby events are selected and coded; the options available to the user; an example of the programme's application in Canada; and a demonstration of its possible use in conjunction with the NEA-IRS.

52293 (CONF-8910192–5) **Seismic, high wind, tornado, and probabilistic risk assessments of the High Flux Isotope Reactor.** Harris, S.P.; Stover, R.L.; Hashimoto, P.S.; Dizon, J.O. Oak Ridge National Lab., TN (USA). 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 2. DOE natural phenomena hazards mitigation conference; Knoxville, TN (USA); 3-5 Oct 1989. Order Number DE90000566. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Natural phenomena analyses were performed on the High Flux Isotope Reactor (HFIR) Deterministic and probabilistic evaluations were made to determine the risks resulting from earthquakes, high winds, and tornadoes. Analytic methods in conjunction with field evaluations and an earthquake experience data base evaluation methods were used to provide more realistic results in a shorter amount of time. Plant modifications completed in preparation for HFIR restart and potential future enhancements are discussed. 5 figs.

52294 (CONF-8910192–6) **Seismic and cask drop excitation evaluation of the tower shielding reactor.** Harris, S.P.; Stover, R.L.; Johnson, J.J.; Sumodobila, B.N. Oak Ridge National Lab., TN (USA). 1989. 7p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. From 2. DOE natural phenomena hazards mitigation conference; Knoxville, TN (USA); 3-5 Oct 1989. Order Number DE90000567. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

During the current shutdown of the Tower Shielding Reactor II (TSR-II), analyses were performed to determine the effect of nearby cask drops on the structural and mechanical integrity of the reactor. This evaluation was then extended to include the effects of earthquakes. Several analytic models were developed to simulate the effects of earthquake and cask drop excitation. A coupled soil-structure model was developed. As a result of the analyses, several hardware modifications and enhancements were implemented to ensure reactor integrity during future operations. 6 figs.

52295 (DOE/FTR–90000101) **Nuclear safety: Foreign trip report, June 16-24, 1989.** Kouts, H. Brookhaven National Lab., Upton, NY (USA). 28 Jul 1989. 83p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC02-76CH00016. Order Number DE90000101. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

During this trip the second INSAG meeting of 1989 was changed by the writer. The meeting took 2 1/2 days (June 21-23). Prior to the formal meeting there were three working group meetings to prepare drafts for INSAG review. Eventually, INSAG approved a report to the Director General containing comments he had requested on the 1991-92 budget. A report reviewing the OSART system and missions was carried to a semi-final state. An important analysis of safety culture was moved along and substantially improved through two successive redraftings. Work on the forthcoming report on the safety of present and future reactors was held off until a draft can be prepared better than the first one which was generated in Vienna two weeks earlier. Nothing was done on the report on the dose-risk relationship a low dose, because the working group chairman. Dr. Beninson, had been suddenly diverted to a trip to the Soviet Union to deal with concerns in Byelorussia concerning contamination residual to the Chernobyl accident. However, INSAG has decided that some redirection of this report is appropriate. A letter was drafted to the Director General, over my signature, urging IAEA action to form an international study of the effects of the Chernobyl accident (this had been proposed to us by the USSR) and to widen the participation in and benefit from activities producing nuclear safety data and understanding of nuclear safety. Discussion with the IAEA staff of scales being adopted in various countries for accident severity led to INSAG's urging the IAEA staff involved to take the initiative toward adopting a single internationally accepted scale of severity.

52296 (DOE/SSDP–0076) **Shippingport Station Decommissioning Project: Activity specification 12: Decontamination topical report.** Westinghouse Hanford Co., Shippingport, PA (USA). Shippingport Station Decommissioning Project Office. 28 Sep 1989. 37p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-84RL10421;AC06-87RL10930. Order Number DE90000546. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This Topical Report is a synopsis of the decontamination of plant components and structures at the Shippingport Station Decommissioning Project (SSDP). The information is provided as a part of the Technology Transfer Program to document the preparation activities in support of the shipment of radioactive wastes and the unconditional release of the site and structural materials. 1 ref., 16 figs., 4 tabs.

52297 (EGG–2575) **Decontamination and decommissioning of Heat Transfer Reactor Eexperiment Test assemblies HTRE-2 and HTRE-3: Final report.** McCusker, T.K. EG and G Idaho, Inc., Idaho Falls, ID (USA). Sep 1989. 51p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC07-76ID01570. Order Number DE90000153. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The purposes of this report are to describe the decontamination and decommissioning (D&D) of Heat Transfer Reactor Experiment (HTRE) test assemblies HTRE-2 and HTRE-3 at the Idaho National Engineering Laboratory during 1987, 1988, and 1989, and the conditions existing after completion of D&D activities. The primary objective of the D&D Project were to remove all accessible radioactive and hazardous contamination from the assemblies, to seal all system openings, and to relocate the assemblies from the Test Area North to the Experimental Breeder Reactor-I area in a safe configuration for permanent public display. 4 refs., 35 figs., 3 tabs.

52298 (EPRI-NP–6152-Vol.2) **Demonstration of reliability-centered maintenance: Volume 2: First annual progress report from San Onofre nuclear generating station.** Anderson, J.G.; Farrell, M.J.; Horn, A.J.; Hughes, E.A.; Levline, R.E.; Rodin, M.E.; Southworth, L.C. Electric Power Research Inst., Palo Alto, CA (USA); Southern California Edison Co., San Clemente, CA (USA); Erin Engineering and Research, Inc., Walnut Creek, CA (USA). c Sep 1989. 120p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

On March 9, 1988 the Southern California Edison Company was selected by the Electric Power Research Institute as one of two utilities to perform a large scale Reliability-Centered Maintenance demonstration project to be co-funded by EPRI and SCE. The overall objective of this project is to demonstrate that RCM can be effectively performed in a plant environment leading to improved overall unit performance. The objective of SCE is to optimize the

existing Preventive Maintenance program at San Onofre Nuclear Generating Station Unit 2. The successful achievement of this goal requires the active involvement and the cooperative efforts of the operations and Maintenance Support, Maintenance, Station Technical, and Operations Divisions. This report describes progress to date in the RCM core elements such as system selection, applications of the RCM methodology to the systems selected, lessons learned, course corrections, implementation of the RCM recommendations, results achieved, and development of a living program. The overall project involves analysis of approximately twelve to sixteen systems. To date, six have been completed and two are underway. The results to date indicate a significant payback in maintenance cost reduction, even with the expansion of some PM activities for identified critical failure modes. 7 refs., 12 figs., 7 tabs.

52299 (EPRI-NP–6152-Vol.3) **Demonstration of reliability-centered maintenance: Volume 3: First annual progress report from Ginna Nuclear Sation.** Edgar, E.C.; Midgett, W.D.; Owsenek, L.W.; Wilson, J.F. Electric Power Research Inst., Palo Alto, CA (USA); Rochester Gas and Electric Corp., NY (USA); Advanced Technology Engineering Systems, Inc., Reston, VA (USA). c Sep 1989. 116p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Earlier single-system pilot studies of Reliability Centered Maintenance (RCM) demonstrated that the RCM methodology is applicable to operating nuclear power plants. This report discusses the full-scale demonstration of RCM on 20 systems at Rochester gas and Electric Corporation's Ginna stations. The objectives of the project is to demonstrate the cost-effectiveness of the approach and feasibility of integration into the operating environment. This interim report identifies why Ginna is performing RCM, the methodologies being used, and the status and results after one year of project activity. The report reflects Ginna's desire to share its RCM Project experience with the nuclear industry with the expectation that the industry will benefit as a result. Ginna is excited about the first year results of the project and is optimistic about its full impact on improvements in its maintenance program. 18 refs., 10 figs., 18 tabs.

52300 (EPRI-NP–6521) **Robotics program development: Applicable lessons learned from TMI-2: Final report.** Schwartz, F.L. Electric Power Research Inst., Palo Alto, CA (USA); Pentek, Inc., Coraopolis, PA (USA). c Sep 1989. 105p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The nuclear industry is becoming increasingly aware of the benefits that can result from the use of robotics technology to augment plant maintenance and monitoring programs. This awareness is growing as a result of various utility successes in deploying robotics tools and realizing benefits to plant operations. These benefits include: (1) reducing occupational exposure risks associated with performing tasks in high radiation zones; (2) reducing fatigue associated with physically demanding tasks; and (3) minimizing human error associated with repetitive tasks. This EPRI-sponsored report addresses the programmatic issues faced by GPU Nuclear in developing a program that extensively employed robotics and remotely controlled equipment. Many of the lessons learned can be applied to an operating plant. This report has been prepared to present generally applicable experiences that a utility may wish to consider when developing a robotics program. Issues addressed within this report can serve as a preliminary guide to: (1) establishing equipment requirements; (2) preparing personnel to implement a robotics program; and (3) determining the impacts on the administrative aspects of operations related to procedures, licensing, and reliability. The Three Mile Island Unit 2 accident created a unique situation within industry; i.e., remotely controlled equipment provided the only viable option for accomplishing a number of recovery tasks. This impetus accelerated the development of practical robotics tooling for specific tasks. 16 refs., 35 figs., 2 tabs.

52301 (EPRI-NP–6541-M) **BWR Pilot Plant life extension study at the Monticello Plant, Phase 2: Final report.** Hagan, K.A.; Hookham, C.J.; Ventura, B.T.; Lewis, J.E.; Lehnert, D.F.; Smith, S.K.; Katz, D.W.; Berg, R.M. Electric Power Research Inst., Palo Alto, CA (USA); Northern States Power Co., Minneapolis, MN (USA); Multiple Dynamics Corp., Southfield, MI (USA). c Sep 1989. 117p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The Monticello BWR Pilot Plant Life Extension Program was initiated in 1985 to examine in some detail the technical and economic viability of life extension for an operating nuclear power plant. The scope of the Phase I study was the identification, importance ranking and life assessment of the critical plant components. The Phase 1 conclusions, based on the initial 27 critical component assessments, contained a number of qualifiers and assumptions with respect to the remaining plant components. To verify the earlier assumptions and to expand the technical bases for a planned future license renewal process, the scope of the Phase 2 program was chosen to include evaluation of many of the remaining plant components and structures and to supplement the technical assessments with in-plant inspections and component condition assessments. Phase 2 also sought to address major issues identified in Phase 1, such as the impact of life extension on the plant's preventive maintenance program. The results of the Phase 2 study are are presented in EPRI Report NP-5836M and in this report. Additionally, Phase 2 targeted higher priority follow-on activities from Phase 1 for implementation. These included a fatigue assessment of the drywell penetration bellows, development of a transient monitoring program for the reactor coolant piping, and implementation of the workbook methodology. The major conclusion of Phase 2 is that the results confirm the feasibility and the prudency of life extension. 15 refs., 11 figs., 12 tabs.

52302 (GRS–90000095) **Radiological bases for decisions on measures for the protection of the population against accidental releases of radionuclides.** (Radiologische grundlagen fuer entscheidungen ueber massnahmen zum schutz der bevoelkerung bei unfallbedingten freisetzungen von radionukliden). 35p. Translated from GRS (Gesellschaft fuer Reaktorsicherheit) Translations, Safety Codes and Guides (F.R. Germany). *GRS (Gesellschaft fuer Reaktorsicherheit) Translations, Safety Codes and Guides (F.R. Germany),* (2): vp (Feb 1989).

These Basic Recommendations replace the Basic Recommendations which were jointly approved by the Federal States Committee for Nuclear Energy and the Ministries of the Interior of the Federal States on March 10/11, 1975 and November 4/5, 1980. The supreme aim of all planning activities is the prevention or limitation of direct consequences of the impacts of nuclear accidents on the population. The term "direct consequences" is understood here to mean nonstochastic effects, and in particular early effects and high individual action by emergency control personnel. The "Radiological Bases for Decisions on Measures for the Protection of the Population against Accidental Releases of Radionuclides" also constitute the basis for this decision; to the extent they are of importance for emergency preparedness they are listed in Appendix 2. 2 figs., 3 tabs.

52303 (IAEA-TECDOC–516, pp. 23-38) **Medical and sanitary measures taken to deal with the consequences of the Chernobyl accident.** Sergeev, G.V. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation Medicine, Kiev (Ukrainian SSR). Jul 1988. (CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

Work was carried out on two fronts: emergency qualified medical aid was organized for those suffering from thermal burns and radiation injuries, and wide-scale prophylactic measures were taken to prevent exposure to radiation and its consequences. More than 600,000 people (including 215,300 children) underwent extensive medical examinations. For prophylactic purposes and in order to diagnose more accurately various diseases which had been identified during the medical surveys, 37,500 people (including 12,600 children) were examined in hospital. (This figure also includes people who made personal requests for such examinations). No abnormalities associated with exposure to radiation were found. At the suggestion of the USSR Ministry of Health, more than 350,000 children and pregnant women were sent to sanatoriums, rest homes

and pioneer camps in 1986-87. The exposure dose to the population as a result of the Chernobyl accident during the next 50-70 years will not exceed more than 20-30% of the dose from natural radiation. (author). 1 fig., 4 tabs.

52304 (IAEA-TECDOC–516, pp. 39-45) **Sanitary and health measures taken to deal with the consequences of the Chernobyl accident.** Kondrusev, A.I. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation Medicine, Kiev (Ukrainian SSR). Jul 1988. (CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

By the end of the first year after the accident, more than 20 million gamma background measurements had been made at population centres; 500,000 samples of drinking water and water from open reservoirs, and 30 million different surfaces (transport vehicles, housing, ground, clothing, etc.), had been tested. Analyses had been made of 700,000 samples of milk and milk products, 120,000 samples of meat and meat products and more than a million samples of other food products. Iodine prophylaxis was administered to 5,400,000 people, including 1,690,000 children. Temporary whole-body exposure limits of 100 mSv (50 mSv for external exposure and 50 mSv for internal exposure) were introduced for the first year after the accident, in the light of scientific data on the effects of various exposure doses and in view of the actual radiation conditions. The standard for 1987-88 was reduced to 3 rem (30 millisievert), in view of the actual reduction in exposure levels achieved as a result of the large-scale clean-up measures undertaken. (author).

52305 (IAEA-TECDOC–516, pp. 47-63) **Chernobyl experience in the context of contemporary radiation protection problems.** Il'in, L.A. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation Medicine, Kiev (Ukrainian SSR). Jul 1988. (CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

Mean individual exposure doses to critical population groups living in the regions under strict control did not exceed the established temporary dose limits for the first and second years after the accident (100 and 30 mSv respectively). The external gamma exposure doses to those living in the contaminated areas did not exceed 50 and 15 mSv, respectively, for 97% of the inhabitants. Internal exposure doses due to incorporated radioactive caesium nuclides did not exceed 50 mSv for the first year and 20 mSv for the second year after the accident for 99% of the population; and for approximately 90% of those living in the regions under control, these doses did not exceed 10 mSv for both the first and second year. It was virtually guaranteed that the doses received by the majority of the population in the regions under control were less than half the temporary dose limits for the first and second years after the accident (for about 95% of the population in the first year and 90% in the second year). Concentrations of radioactive caesium in the bodies of those living in the regions under control were on average 2-5 times lower in the summer of 1987 than in the summer of 1986, and in some cases the difference was measured by factors of 7-10. The implementation of the whole complex of measures brought about a 5 to 20-fold decrease in the thyroid dose commitment for children, a 1.3 to 2.5-fold decrease in the external gamma dose (depending on occupation and age) and a 10-fold or greater decrease in internal exposure doses. (author). 8 refs, 5 figs, 1 tab.

52306 (IAEA-TECDOC–516, pp. 65-78) **Protection of health during a large scale accident.** Romanenko, A.E. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation Medicine, Kiev (Ukrainian SSR). Jul 1988. (CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

The general principles applied in planning measures to protect the population covered four periods: (1) the 24 hours following the accident; (2) 2-7 days after the accident; (3) 2-6 weeks after the accident; (4) the subsequent period. In order to carry out medical examinations and provide medical care for those who had been evacuated and those living in regions with high levels of radiation, about 2,000 doctors, 4,000 intermediate-level medical assistants and more than 1,200 senior students at medical institutes were involved. In the first period, 230 laboratory-dosimetric mobile teams were set up and more than 400 teams of doctors, including 212 specialized teams for examining children and pregnant women. The epidemic control stations in these regions were supported by shift teams from epidemic control stations in other regions. A total of 330 doctors, 600 intermediate-level assistants, 125 special vehicles and so on were involved. Over the whole period about 500,000 people were examined, including 100,000 children; more than 500,000 haematological and 54,000 hormonal studies were carried out, and more than 200,000 measurements of iodine and caesium in the bodies of affected individuals were made. (author).

52307 (IAEA-TECDOC–516, pp. 81-89) **Theory and practice of establishing radiation standards before and after the Chernobyl accident.** Buldakov, L.A.; Avetisov, G.M.; Balonov, M.I.; Konstantinov, Yu.O. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation Medicine, Kiev (Ukrainian SSR). Jul 1988. (CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

If the external gamma dose to the whole body or exposure of the thyroid gland does not exceed 0.25 Gy, there is no need to adopt emergency measures which would temporarily disrupt the life of the population. If external exposure exceeds these levels but does not exceed 0.75 Gy, or if the dose to the thyroid gland from ^{131}I exceeds 2.5 Gy, then ad hoc decisions have to be taken in accordance with the actual circumstances encountered. Doses of less than 0.25 Gy are virtually harmless to the individual, a dose of 0.25 Gy is considered potentially dangerous, and at doses of 0.75 Gy for whole-body exposure or 2.5 Gy for local exposure of the thyroid gland, radiation sickness or pathological changes in the gland may occur in some cases. External exposure doses to the population in the most severely contaminated regions of the Ukraine during the first year after the accident lay in the range 0.7-2.5 rem, and internal exposure doses - assessed from the results of 52,000 examinations - did not exceed 1 rem in 90% of cases. Only in 230 cases did the anticipated doses exceed 5 rem. The concentration of the main dose-forming nuclides, caesium-137 and caesium-134, in milk products, potatoes, vegetables and fruit produced in the contaminated region outside the 30-km zone was 0.5×10^{-8} Ci/kg. (author).

52308 (IAEA-TECDOC–516, pp. 91-99) **Radioactive contamination of water ecosystems and sources of drinking water.** Likhtarev, I.A.; Barkhudarov, R.M.; Bobyleva, O.A.; Knizhnikov, V.A.; Logachev, V.A.; Ramzaev, P.V.; Savkin, M.N.; Sergeev, G.V. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation Medicine, Kiev (Ukrainian SSR). Jul 1988. (CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

The contribution of aqueous components to the individual and collective doses received by the population as a result of the accident at Chernobyl in 1986 did not exceed 1-2%. In the first few days after the accident, the total beta radioactivity of the water was 1×10^{-7} Ci/L. Subsequently, the concentration of radionuclides in

the water fell steadily and throughout 1987 was stable at 1-3x10^{-10} Ci/L. The highest recorded figure was 4x10^{-9} Ci/L in May 1986 caused by iodine-131 (for the Dnepr). (author). 1 fig.

52309 (IAEA-TECDOC–516, pp. 101-116) **Intake of radionuclides through food chains as a factor in the exposure of the Soviet population after the Chernobyl accident.** Knizhnikov, V.A.; Barkhudarov, R.M.; Bruk, G.Ya. and others. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation Medicine, Kiev (Ukrainian SSR). Jul 1988. (CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

In the first few days after the accident, a standard (of 1x10^{-7} Ci/L) was established for the concentration of iodine in milk, calculated to ensure that the dose to the thyroid gland would not exceed 30 rem. Temporary permissible levels for the concentration of radioactive substances in 24 types of food, water and medical material were established and implemented on 30 May 1986. The highest concentrations of radiocaesium in milk recorded in 1986 were 3-5x10^{-7} Ci/L. Unrestricted consumption of that milk could have led to a daily intake of 3000-5000x10^{-10} Ci of radiocaesium. Those individuals who had consumed such milk were identified. The average levels of radiocaesium per region did not exceed the emergency standards. The actual concentrations of radiostrontium in food products did not exceed the temporary permissible levels calculated for this dose and in most cases were 10-100 times less as a result of the control measures which were implemented. Standards, monitoring and classification of foodstuffs were introduced to reduce the internal exposure dose by a factor of 10-30, down to levels which were not only in line with the temporary limits but also with the radiation safety standards (NRB-76). The concentration of strontium-90 in all the main food products studied was relatively insignificant - namely about 0.3-3% of the radiocaesium concentration. (author). 11 tabs.

52310 (IAEA-TECDOC–516, pp. 117-132) **Characteristics of radionuclide intake by inhalation.** Khrushch, V.T.; Gavrilin, Yu.I.; Konstantinov, Yu.O.; Kochetkov, O.A.; Margulis, U.Ya.; Popov, V.I.; Repin, V.S.; Chumak, V.V. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation Medicine, Kiev (Ukrainian SSR). Jul 1988. (CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

Internal exposure of all organs other than bone tissue by inhalation of a mixture of radionuclides virtually ceased by the end of the first year after the accident. Comparatively intensive fallout from the radioactive plume took place in the town of Pripyat' late in the evening and during the night of 26-27 April 1986. The density of contamination in certain streets of the town by iodine-131 at the time evacuation began was estimated to be of the order of (1-70)x10^6 Bq/m^2 (30-2000 μCi/m^2). This gives a value of intake by inhalation of (0.3-20)x10^6 Bq (10-700 μCi), which corresponds to an absorbed dose to the thyroid gland in adults of 0.2-14 Gy (20-1400 rad). The actual results of measurements were significantly lower than the maximum estimate. The main contribution to the predicted 50-year dose equivalent commitment for bone tissue is from transuranium elements, and exposure during the first year corresponds to about 1/4 of the maximum permissible dose for occupationally exposed persons. (author). 3 figs, 6 tabs.

52311 (IAEA-TECDOC–516, pp. 133-138) **Sanitary-dosimetric monitoring of food products.** Bur'yak, V.N.; Novikova, N.Ya.; Khulap, Z.A.; Tsvirbut, A.I. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation Medicine, Kiev (Ukrainian SSR). Jul 1988. (CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

Most of the monitoring measures implemented in the regions of greatest radioactive contamination were carried out for meat and milk products (36%) and water (45%). The efficiency of the control measures carried out during the first few months was estimated at 80-90%, and subsequently at 90-95%. (author). 1 tab.

52312 (IAEA-TECDOC–516, pp. 139-144) **Radiation monitoring of various objects as part of the Chernobyl accident management programme.** Kochetkov, O.A.; Gol'dshtejn, D.S.; Osanov, D.P. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation Medicine, Kiev (Ukrainian SSR). Jul 1988. (CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

Permissible levels of radioactive contamination were based primarily on an experimentally established relationship for contamination in the region around the Chernobyl power plant: the gamma exposure dose rate measured close to a contaminated flat surface, 1 mR/h, is equivalent to 10,000 beta particles/cm^2center dotmin. From this relationship, it follows that the established contamination limit of 0.1 mR/h roughly corresponds to the limit for contamination of the outer protective clothing worn by staff at nuclear power plants as laid down in the radiation safety standards (NRB-76), namely 800 beta particles/cm^2center dotmin. Experience in establishing radioactive contamination standards and in organizing radiation monitoring made it possible to reduce significantly the adverse effects of the accident. (author). 1 tab.

52313 (IAEA-TECDOC–516, pp. 145-150) **Personnel protection during a reactor accident.** Koshcheev, V.S.; Korostin, A.S.; Rajkhman, S.P. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation Medicine, Kiev (Ukrainian SSR). Jul 1988. (CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

In organizing individual protection and the provision of protective clothing and equipment for accident teams, particular attention must be paid to protection of the respiratory organs. A system of disciplinary barriers, personnel airlocks and gates and transport processing points - with obligatory monitoring of all movements of staff and equipment - is described. (author).

52314 (IAEA-TECDOC–516, pp. 151-164) **Protective measures to reduce population exposure doses and effectiveness of these measures.** Avetisov, G.M.; Aleksakhin, R.M.; Antonov, V.P. and others. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation Medicine, Kiev (Ukrainian SSR). Jul 1988. (CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

Basic measures to protect the population from radiation after the Chernobyl accident included: (i) monitoring of radiation conditions and exposure doses to the population; (ii) temporary or permanent evacuation of certain population groups; (iii) iodine prophylaxis; (iv) limitation of the intake of radionuclides with food products; (v) decontamination of land and buildings; and (vi) educational work and sanitary instructions to the population. More than 5,000,000 measurements were carried out on different objects. In some population centres external doses exceeded level A, reaching 0.3-0.4 Gy, but nowhere did they reach the upper level B. More than 70,000 farms were decontaminated an a total of about 200,000 m^3 of contaminated soil was removed from large areas, taken away and buried.

In 1987, as a result of these effective measures, the contribution to the dose from internal exposure averaged only 10-30%. The overall effectiveness of the protection of the population living in the zones of radioactive contamination can be expressed in terms of the conservation of 7,000 man-years of normal life. (author). 5 refs.

52315 (IAEA-TECDOC–516, pp. 171-182) **Methodological principles for calculating levels of external and internal exposure of the population used in taking strategic decisions.** Barkhudarov, R.M.; Gordeev, K.I.; Dibobes, I.K. and others. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation Medicine, Kiev (Ukrainian SSR). Jul 1988. (CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

The significance of each of the factors involved in internal and external exposure of the population can vary considerably as a function of the specific exposure conditions or the time which has elapsed since the accident. If data on the radionuclide composition of the fallout are available, dose rate dynamics can be calculated in accordance with the law of radioactive decay for the mixture of interest. After four years the reduction in the dose rate follows the law of caesium-137 decay in soil, and the effective period of removal of half the radioactivity from the body is $T^{eff}1/2 = 14$ years (Biophysics Institute of the USSR Ministry of Health) (according to other data 7 or 5 years). In the first year after the accident, the effective dose equivalent to the human body was determined by strontium-90 and strontium-89. The EDE (Effective Dose Equivalent) for subsequent years and the integrated 50-year EDE will be governed almost completely by strontium-90. (author). 2 tabs.

52316 (IAEA-TECDOC–516, pp. 183-194) **Dynamics of gamma radiation levels and formation of external exposure dose.** Logachev, V.A.; Los', I.P.; Parkhomenko, V.I.; Savkin, M.N.; Titov, A.V. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation Medicine, Kiev (Ukrainian SSR). Jul 1988. (CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

From the first day after the accident, gamma radiation fields throughout the country were systematically observed and data collected and analysed. In the first stage, the availability of such dynamic data for each population centre made it possible to obtain reliable estimates of external exposure doses to the population up to the time of evacuation, which, in the majority of centres evacuated, did not exceed 0.1 Gy and in the others did not exceed level B (0.75 Gy) taken as the upper level. The decontamination measures carried out made it possible to reduce the exposure dose by a factor of 1.3-2.5 in comparison with the anticipated doses for different occupational and age groups. The maximum reduction was noted in children. (author). 10 figs, 3 tabs.

52317 (IAEA-TECDOC–516, pp. 195-201) **Monitoring of internal exposure of the population in regions close to the Chernobyl nuclear power plant.** Gusev, I.A.; Likhtarev, I.A.; Dolgirev, E.I.; Zhakov, I.G.; Ledoshchuk, B.A.; Ramzaev, P.V. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation Medicine, Kiev (Ukrainian SSR). Jul 1988. (CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

In the first month and a half after the accident, the dose burden on the population was determined by radioactive iodine deposited in the thyroid gland. Later, the dose burden was governed by caesium-134 and caesium-137. The measurements made are generally reliable. Departures from the norm in extreme cases (in the event of marked differences from the standard body build) were no more than 50% of the actual activity (at levels above 150-200 nCi). Since there is no effective method of measuring nuclides incorporated into the bodies of children, it is necessary to develop special phantoms simulating the human body at different ages. (author). 4 tabs.

52318 (IAEA-TECDOC–516, pp. 203-215) **Methods for retrospective determination of absorbed doses in the human body resulting from external and internal exposure.** Balonov, M.I.; Keirim-Markus, I.B.; Margulis, U.Ya.; Osanov, D.P. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation Medicine, Kiev (Ukrainian SSR). Jul 1988. (CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

In order to estimate the absorbed dose to surface tissues in people working in a contaminated area, a calculation method has been developed based on area integration of the modified response function for a point beta-gamma source. Practical testing of the method in real conditions confirmed its usefulness for prognostic evaluations. The main contribution to the dose is made by beta radiation with a limiting energy of 1.0-3.5 MeV and by gamma radiation with an effective energy of 20 KeV. The population centres studied were divided into towns and villages and the inhabitants were divided into seven age groups. Preliminary data from an analysis of the radiation burden of the population in regions adjacent to the Chernobyl power plant zone show that the evacuation of the population from the 30-km zone and other steps taken to organize living arrangements in these regions brought about a radical drop in the levels of population exposure. (author).

52319 (IAEA-TECDOC–516, pp. 217-228) **Long term prognosis of individual and collective exposure doses to the population.** Pavlovskij, O.A. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation Medicine, Kiev (Ukrainian SSR). Jul 1988. (CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

For the purpose of evaluating the long-term consequences of radiation contamination following the Chernobyl accident, it was decided to divide the whole of the Soviet Union into a number of regions. Calculations were made with a special software package. The collective dose commitment to the country's population due to caesium isotopes will amount to 117,000 man-Sv, of which the first year accounted for about 27%. Thus, the main contribution to the aggregate dose will be made in the second and subsequent years, i.e., a period when the formation of dose burdens to the population can be effectively influenced by strict monitoring of agricultural products, agrotechnical measures in the contaminated area and even by a thoroughgoing reformation of the economy. Many of these measures have already been taken in the USSR. On the whole, the average individual dose commitment to the country's population will be about 1.2 mSv, which, given an annual level of background radiation in the USSR of 1 mSv/year, adds only 2% to the natural background dose. In view of all the measures taken, the main contribution to the population dose commitment comes from external gamma radiation from the radioactive products released during the accident - ?% - and about 38% from internal exposure resulting from the consumption of contaminated food products. (author). 9 refs, 5 tabs.

52320 (IAEA-TECDOC–516, pp. 315-325) **Medical demographic consequences of the Chernobyl accident.** Omel'yanets, N.I.; Miretskij, G.I.; Saurov, M.M.; Torbin, V.F. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation

Medicine, Kiev (Ukrainian SSR). Jul 1988. (CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

A demographic study was made of the population evacuated from the 30-km zone around the nuclear power plant and of the population living in areas over which the radioactive cloud passed and over which the plume was formed. For the farmers evacuated from 11,655 homes in the Chernobyl region, 7,000 new houses, built in the Kiev region, had already been provided within 5 months of the accident, and by the summer of 1987 another 5,000 houses were available. A study of the resettlement of the population carried out a year after the accident showed that more than 60% of those evacuated continued to live in the regions from which the evacuation had taken place; about 5% were resettled in other republics, and 20% within their own republic. (author). 7 figs, 2 tabs.

52321 (IAEA-TECDOC–516, pp. 327-332) **Organizational, methodological and information aspects of the mass individual dosimetric surveys carried out in contaminated areas following the Chernobyl accident.** Tsyb, A.F.; Stepanenko, V.F.; Pitkevich, V.A. and others. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation Medicine, Kiev (Ukrainian SSR). Jul 1988. (CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

The dosimetric surveys carried out after the Chernobyl accident relied on a preliminary evaluation of radiation conditions shortly after the explosion and were backed up by special arrangements on the personnel and organizational side, as well as by appropriate information techniques and methodology. The calculational part of the work involved the use of mathematical models and a special computer program for the dosimetric calculations. The models include parameters agreed upon by leading experts of NCRP (USSR Ministry of Health) and make it possible to adapt the dosimetric calculations to various situations corresponding to the sex, age, height and body mass of those examined, their whereabouts and type of nutrition in the controlled zone, and the frequency of contact with radioactivity. The computer programs are designed for speedy calculations and allow an assessment of absorbed doses in field conditions (using small computer technology) and in hospital conditions (at different levels of the all-Union distribution register). (author).

52322 (IAEA-TECDOC–516, pp. 333-344) **Database for a systems analytical approach to studying the medical aspects of the Chernobyl accident.** Linge, I.I.; Dushutin, K.K.; Zajtseva, I.G.; Kovgan, L.N.; Labuzov, S.G.; Nigiyan, A.A.; Khokhlov, V.F. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation Medicine, Kiev (Ukrainian SSR). Jul 1988. (CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

The main elements of the program data base were the all-Union distribution register and the SDACHA computer system (Chernobyl accident data system) which ensured reliable functioning of the PRI-ORRA expert system (acronym stands for "taking of optimum decisions in the event of a radiation accident"). The development of criteria for the optimum selection of countermeasures follows three paths - medical, economic and social - and is based on a regulatory document entitled "criteria for taking decisions or measures to protect the population in the event of a reactor accident". (author). 1 ref., 3 figs.

52323 (INIS-mf–12000) **Survey of incidents in West German nuclear power plants in the last quarter of the year 1988.** Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.). 1989. 11p. (In German). Order Number DE90711369. Available from NTIS (US Sales Only), PC A03/MF A01.

There were 79 incidents reported. Six incidents belong to reporting category E (immediate notification), the remaining 73 incidents belong to reporting category N (normal notification). The survey covers all incidents reported to GRS until the 15th of February 1989 and also includes incidents that happened before the last quarter of 1988 but were recorded later. There was no release of radioactivity involved in the incidents, and there are no effects on man or the environment reported. (orig./HP).

52324 (INIS-mf–12003) **Monitoring of nuclear facilities in Nordrhein-Westfalen. Vol. 1. Summary of expert opinion.** Ministerium fuer Wirtschaft, Mittelstand und Technologie des Landes Nordrhein-Westfalen, Duesseldorf (Germany, F.R.); Elektrowatt Ingenieurunternehmung G.m.b.H. (EWI), Mannheim (Germany, F.R.). Oct 1988. 134p. (In German). Order Number DE90711229. Available from NTIS (US Sales Only), PC A07/MF A01.

The safety-relevant testing of nuclear installations, which differ in terms of construction type, was performed with standardized methods based largely on the 1977 safety criteria for nuclear power stations of the Federal Ministry of the Interior (BMI). These were directly applicable, in their general sense, to the nuclear power stations Wuergassen, THTR-300, AVR and FRJ-2. The same criteria were also applied accordingly, where appropriate, to the Large Hot Cells in Juelich. For the uranium enrichment plant of Gronau, the testing was oriented to the 1983 safety requirements for nuclear fuel supply plants of the BMI. The actual state of each of the plants approved was registered with respect to the required safety criterion and systematically tested in anticipation of possible deviations ('Deltas'), 'Chernobyl-type characteristics' and relevant 'objections by critics'. (orig./DG).

52325 (JAERI-M–89-051) **Depressurization test on hot gas duct.** Tanihira, Masanori; Kunitomi; Kazuhiko; Inagaki, Yoshiyuki; Miyamoto, Yoshiaki; Sato, Yutaka. Japan Atomic Energy Research Inst., Tokyo (Japan). May 1989. 64p. (In Japanese). Order Number DE90710058. Available from NTIS (US Sales Only), PC A04/MF A01.

To study the integrity of internal structures and the characteristics in a hot gas duct under the rapid depressurization accident, depressurization tests have been carried out using a test apparatus installed the hot gas duct with the same size and the same structures as that of the High Temperature Engineering Test Reactor (HTTR). The tests have been performed with three parameters: depressurization rate (0.14-3.08 MPa/s) determined by orifice diameter, area of the open space at the slide joint (11.9-2036 mm^2), and initial pressure (1.0-4.0 MPa) filled up in a pressure vessel, by using nitrogen gas and helium gas. The maximum pressure difference applied on the internal structures of the hot gas duct was 2.69 MPa on the liner tube and 0.45 MPa on the separating plate. After all tests were completed, the hot gas duct which was used in the tests was disassembled. Inspection revealed that there were no failure and no deformation on the internal structures such as separating plates, insulation layers, a liner tube and a pressure tube. (author).

52326 (KFK–4585) **Evaluation of forced reflooding experiments in APWR-geometry (NEPTUN-III facility) using the advanced computer code FLUT-FDWR.** Cigarini, M. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projektgruppe LWR-Sicherheit (PRS). Jun 1989. 35p. Order Number DE90711707. Available from NTIS (US Sales Only), PC A03/MF A01.

A new version of the GRS computer code FLUT, named FLUT-FDWR, was recently developed in KfK in order to provide an adequate computational means for analysing the behaviour of the most important APWR designs during the reflooding phase after a LOCA. The Code was checked by means of post-test calculations of experiments in PWR as well as in a very tight APWR geometry. The present work shows the results of calculations for a wider

APWR geometry (NEPTUN-III facility) and can be seen as a further step in the code validation for APWR applications. (orig.).

52327 (LLNL–90000164) **Nuclear criticality safety assessment calculations: Part 1, Calculating power histories in nuclear excursions.** Lutz, H.F.; Kroopnick, H.J. (ed.). Lawrence Livermore National Lab., CA (USA). 17 Jun 1985. 70p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90000164. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

We will develop the lumped-parameter model for nuclear kinetics and exploit certain useful approximations of that model. The lumped-parameter model, which eliminates detailed properties of the system by means of same averaging process, is usually called the point-reactor model. As we will see, the equations that describe the point-reactor model depend only on the time variable. Effects produced by geometry or energy of the neutron are contained in the parameters of the point-reactor model. The point-reactor model is satisfactory only when the chain-reacting system is close to critical. This restriction allows us to treat most cases of practical interest. For example, we want to describe how energy is generated during an excursion. Below critical, the power of a chain-reacting system decreases; above critical, it increases. It is difficult to increase the reactivity of a chain-reacting system very much above critical because the energy deposited in the system by the fission process shuts down the excursion. Hence, we only need a dynamic model that is valid near critical. The point-reactor model, of course, cannot describe spatially dependent dynamic effect. Our purpose in describing the point-reactor model is twofold. First, we want to give the reader an understanding of the phenomena involved in an accidental nuclear excursion. How much energy is likely to be produced during an accident? What is the behavior in time of the energy released? What properties of the system determine the shutdown mechanism of the nuclear excursion? Second, we want to give the criticality safety specialist some computational tools for estimating the behavior of an accidental nuclear excursion when the parameters describing the chain-reacting system are not precisely known. 22 figs.

52328 (NIRS-M–68) **Radiological consequence of Chernobyl nuclear power accident in Japan. Review of radioecological studies and the dose assessment on Japanese for the period of 1 year after the accident.** Uchiyama, Masafumi; Nakamura, Yuji; Kankura, Takako; Iwasaki, Tamiko; Fujimoto, Kenzo; Kobayashi, Sadayoshi. National Inst. of Radiological Sciences, Chiba (Japan). Mar 1988. 258p. (In Japanese). Order Number DE90710177. Available from NTIS (US Sales Only), PC A12/MF A01.

Two years have elapsed since the accident in Chernobyl nuclear power station shocked those concerned with nuclear power generation. The effect that this accident exerted on human environment has still continued directly and indirectly, and the reports on the effect have been made in various countries and by international organizations. In Japan, about the exposure dose of Japanese people due to this accident, the Nuclear Safety Commission and Japan Atomic Energy Research Institute issued the reports. In this report, the available data concerning the envrionmental radioactivity level in Japan due to the Chernobyl accident are collected, and the evaluation of exposure dose which seems most appropriate from the present day scientific viewpoint was attempted by the detailed analysis in the National Institute of Radiological Sciences. The enormous number of the data observed in various parts of Japan were different in sampling, locality, time and measuring method, so difficulty arose frequently. The maximum concentration of I-131 in floating dust was 2.5 Bq/m^3 observed in Fukui, and the same kinds of radioactive nuclides as those in Europe were detected. (Kako, I.).

52329 (NUREG–0975-Vol.7, pp. 292-301) **Evaluation of nuclear facility decommissioning projects (ENFDP) program.** Haffner, D.R. (Westinghouse Hanford Co., Richland, WA (USA)); Doerge, D.H. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering. May 1989. In *Compilation of contract research for the Materials Engineering Branch, Division of Engineers. Annual report for FY 1988.* Order Number DE89011888. Available from NTIS, PC A16/MF A01 - I.

Major studies have been undertaken in recent years by the US Nuclear Regulatory Commission (NRC) and others, on the technology, safety, and costs associated with the decommissioning of nuclear facilities. The Evaluation of Nuclear Facility Decommissioning Projects (ENFDP) Program described in this report is being undertaken by the NRC to compile and evaluate the activities of ongoing decommissioning projects both within the US and abroad. Assessment and evaluation of the methods, impacts, and costs will provide bases for evaluating licensee's proposed decommissioning plans, and for future decommissioning guidance and regulation. This report discusses Fiscal Year (FY) 1988 work scope, research progress made in FY 1988, and future research plans of the ENFDP Program.

52330 (NUREG–1233) **Regulatory analysis for USI A-40, "Seismic Design Criteria": Final report.** Shaukat, S.K.; Chokshi, N.C. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Issue Resolution. Sep 1989. 18p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A03/MF A01 - GPO; OSTI; INIS.

This report presents the regulatory analysis conducted by the NRC staff for the resolution of Unresolved Safety Issue (USI) A-40, "Seismic Design Criteria." The regulatory analysis discusses the impact of the proposed changes in Standard Review Plan (NUREG-0800) Sections 2.5.2, 3.7.1, 3.7.2, and 3.7.3 as the resolution. 14 refs., 3 tabs.

52331 (NUREG–1267) **Technical resolution of Generic Safety Issue A-29: Nuclear power plant design for reduction of vulnerability to industrial sabotage.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Issue Resolution. Sep 1989. 26p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A03/MF A01 - GPO; OSTI; INIS.

This report summarizes key technical findings related to Generic Safety Issue A-29, "Nuclear Power Plant Design for Reduction of Vulnerability to Industrial Sabotage." The findings in this report deal with (1) a historical review of reported sabotage-related events at nuclear facilities, (2) NRC physical security requirements, (3) industry measures to prevent/mitigate sabotage, (4) design and procedural approaches that could be used to deter sabotage, (5) current NRC and industry initiatives aimed at personnel screening and selection, and (6) design considerations applicable to Advanced Light Water Reactors (ALWRs). The results reveal that insider sabotage at operating nuclear plants has not been a significant problem in the United States to date and that there are no singular design modifications or procedures that by themselves would completely eliminate or mitigate the threat of insider sabotage. Rather, it will take a combination of systematic and focused improvements in the three areas of reliable personnel, effective design features, and plant procedures developed to provide a strategy to deal with prevention of insider sabotage and to be able to mitigate adverse actions. 24 refs., 2 figs., 5 tabs.

52332 (NUREG–1307-Rev.1) **Report on waste burial charges: Escalation of decommissioning waste disposal costs at low-level waste burial facilities: Revision 1.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering. Oct 1989. 34p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A03/MF A01 - GPO; OSTI; INIS.

One of the requirements placed upon nuclear power reactor licensees by the US Nuclear Regulatory Commission (NRC) is for the licensees to periodically adjust the estimate of the cost of decommissioning their plant, in dollars of the current year, as part of the process to provide reasonable assurance that adequate funds for decommissioning will be available when added. This report, which is scheduled to be revised annually, contains the development of a formula for escalating decommissioning cost estimates that is acceptable to the NRC. The sources of information to be used in the escalation formula are identified, and the values developed for the escalation of radioactive waste burial costs, by site and by year, are given in this report. The licensees may use the formula, the coefficients, and the burial escalation factors from this report in their escalation analysis, or may use an escalation rate at least equal to the escalation approach presented herein. The formula and its coefficients, together with guidance to the appropriate sources of data, are summarized in Chapter 2. The development of the formula and

its coefficients are presented in Chapter 3. Price schedules for burial for the year of issue of this report are given in Appendix A, for currently operating burial sites. The calculations performed to determine the burial cost escalation factors, B_x, for each site for the year 1988 are summarized in Appendix B. 4 refs., 6 tabs.

52333 (NUREG–1370) **Resolution of Unresolved Safety Issue A-48, "Hydrogen control measures and effects of hydrogen burns on safety equipment".** Ferrell, C.M.; Soffer, L. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Issue Resolution. Sep 1989. 139p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A10/MF A01 - GPO; OSTI; INIS.

Unresolved Safety Issue (USI) A-48 arose as a result of the large amount of hydrogen generated and burned within containment during the Three Mile Island accident. This issue covers hydrogen control measures for recoverable degraded-core accidents for all boiling-water reactors (BWRs) and those pressurized-water reactors (PWRs) with ice-condenser containments. The Commission and the nuclear industry have sponsored extensive research in this area, which has led to significant revision of the Commission's hydrogen control regulations, given in Title 10, Code of Federal Regulations, Part 50 (10 CFR 50), Section 50.44. BWRs having Mark I and II containments are presently required to operate with inerted containment atmospheres that effectively prevent hydrogen combustion. BWRs with Mark III containments and PWRs with ice-condenser containments are now required to be equipped with hydrogen control systems to protect containment integrity and safety systems inside containment. Industry has chosen to use hydrogen igniter systems to burn hydrogen produced in a controlled fashion to prevent damage. An independent review by a Committee of the National Research Council concluded that, for most accident scenarios, current regulatory requirements make it highly unlikely that hydrogen detonation would be the cause of containment failure. On the basis of the extensive research effort conducted and current regulatory requirements, including their implementation, the staff concludes that no new regulatory guidance on hydrogen control for recoverable degraded-core accidents for these types of plants is necessary and that USI A-48 is resolved.

52334 (NUREG/CR–4550-Vol.6-Rev.1-Pt.1) **Analysis of core damage frequency: Grand Gulf, Unit 1 internal events.** Drouin, M.T.; LaChance, J.L.; Shapiro, B.J.; Miller, S.; Wheeler, T.A. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research; Sandia National Labs., Albuquerque, NM (USA). Aug 1989. 548p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (SAND–86-2084-Vol.6-Rev.1-Pt.1). Available from NTIS, PC A23/MF A01 - GPO; OSTI; INIS.

This document contains the accident sequence analysis of internally initiated events for the Grand Gulf Unit 1, Nuclear Power Plant. This is one of the five plant analyses conducted as part of the NUREG-1150 effort for the Nuclear Regulatory Commission. The work performed and described here is an extensive reanalysis of that published in April 1987 as NUREG/CR-4550/Volume 6. It addresses comments from numerous reviewers and significant changes to the plant systems and procedures made since the first report. The uncertainty analysis and presentation of results are also much improved and considerable effort was expended on an improved analysis of loss of offsite power. The content and detail of this report are directed toward Probabilistic Risk Assessment practitioners who need to know how the work was done and the details for use in further studies. The mean core damage frequency is 4.0E-6 with 5% and 95% uncertainty bounds of 1.7E-7 and 1.2E-5, respectively. Station blackout type accidents (loss of all ac power) dominate the overall results, contributing about 97% of the core damage frequency. Anticipated transient without scram accidents contributed another 3%. The numerical results are driven by loss of offsite power, failure of the diesel generators, failure of the steam-driven reactor core isolation cooling system, and common cause failure of the batteries. 64 refs., 62 figs., 74 tabs.

52335 (NUREG/CR–4550-Vol.6-Rev.1-Pt.2) **Analysis of core damage frequency: Grand Gulf, Unit 1 internal events appendices.** Drouin, M.T.; LaChance, J.L.; Shapiro, B.J.; Miller, S.; Wheeler, T.A. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research; Sandia National Labs., Albuquerque, NM (USA). Sep 1989. 857p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (SAND–86-2084-Vol.6-Rev.1-Pt.2). Available from NTIS, PC A99/MF A01 - GPO; OSTI; INIS.

This document contains the appendices for the accident sequence analysis of internally initiated events for the Grand Gulf Unit 1, Nuclear Power Plant. This is one of the five plant analyses conducted as part of the NUREG-1150 effort for the Nuclear Regulatory Commission. The work performed and described here is an extensive reanalysis of that published in April 1987 as NUREG/CR-4550, Volume 6. It addresses comments from numerous reviewers and significant changes to the plant systems and procedures made since the first report. The uncertainty analysis and presentation of results are also much improved, and considerable effort was expended on an improved analysis loss of offsite power. The content and detail of this report are directed toward Probabilistic Risk Assessment practitioners who need to know how the work was done and the details for use in further studies. The mean core damage frequency is 4.0E-6 with 5% and 95% uncertainty bounds of 1.7E-7 and 1.2E-5, respectively. Station blackout type accidents (loss of all ac power) dominate the overall results contributing about 97% of the core damage frequency. Anticipated transient without scram accidents contributed another 3%. The numerical results are driven by loss of offsite power, failure of the diesel generators, failure of the steam-driven reactor core isolation cooling system, and common cause failure of the batteries. 4 refs., 5 figs., 2 tabs.

52336 (NUREG/CR–5174) **A reference manual for the Event Progression Analysis Code (EVNTRE).** Griesmeyer, J.M.; Smith, L.N. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research; Sandia National Labs., Albuquerque, NM (USA). Sep 1989. 67p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (SAND–88-1607). Available from NTIS, PC A10/MF A01 - GPO; OSTI; INIS.

This document is a reference guide for the Event Progression Analysis (EVNTRE) code developed at Sandia National Laboratories. EVNTRE is designed to process the large accident progression event trees and associated files used in probabilistic risk analyses for nuclear power plants. However, the general nature of EVNTRE makes it applicable to a wide variety of analyses that involve the investigation of a progression of events which lead to a large number of sets of conditions or scenarios. The EVNTRE code efficiently processes large, complex event trees. It has the capability to assign probabilities to event tree branch points in several different ways, to classify pathways or outcomes into user-specified groupings, and to sample input distributions of probabilities and parameters.

52337 (NUREG/CR–5263) **The risk management implications of NUREG–1150 methods and results.** Camp, A.L.; Maloney, K.J.; Sype, T.T. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research; Sandia National Labs., Albuquerque, NM (USA). Sep 1989. 177p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (SAND–88-3100). Available from NTIS, PC A09/MF A01 - GPO; OSTI; INIS.

This report describes the potential uses of NUREG-1150 and similar Probabilistic Risk Assessments (PRAs) in NRC and industry risk management programs. NUREG-1150 uses state-of-the-art PRA techniques to estimate the risk from five nuclear power plants. The methods and results produced in NUREG-1150 provide a framework within which current risk management strategies can be evaluated, and future risk management programs can be developed and assessed. While the development of plant-specific risk management strategies is beyond the scope of this document, examples of the use of the NUREG-1150 framework for identifying and evaluating risk management options are presented. All phases of risk management from prevention of initiating events though reduction of offsite consequences are discussed, with particular attention given to the early phase of accidents. 14 refs., 9 figs., 28 tabs.

52338 (ORNL/FTR–2528) **[Discussion of advanced instrumentation for reflood studies]: Foreign trip report, January 25, 1987–March 21, 1987.** Smith, J.E.; Payne, H.R.; Griffies, C.D.; Hill, T.G. Oak Ridge National Lab., TN (USA). 14 Apr 1987. 9p. Sponsored by Nuclear Regulatory Commission. DOE Contract

AC05-84OR21400. Order Number DE89017308. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Over an operational period of two years, nineteen out of 130 ORNL-supplied instruments at the UPTF facility developed malfunctions. During a scheduled outage period to correct these and other problems at the facility, the travelers participated in the removal, replacement and reinstallation activities including calibration of the ORNL instruments.

52339 (ORNL/FTR–2610) **[Aging and maintenance of nuclear power plants]: Foreign trip report, June 26–July 5, 1987.** Eissenberg, D.M. Oak Ridge National Lab., TN (USA). 20 Jul 1987. 29p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. Order Number DE89017349. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The purpose of the Symposium, "Application of Diagnostics to Determine the Operational Readiness of Aged Motor-Operated Valves," was to provide a forum for the exchange of technical information on the approach to the aging phenomena at nuclear power plants and for the exchange of technical and economic information on the approach to plant life extension. A total of 45 papers were presented in 6 regular sessions and a poster session. In addition there were 3 panel discussions.

52340 (ORNL/FTR–2909) **[Nuclear reactor severe accident chemistry]: Foreign trip report, June 4, 1988–June 10, 1988.** Malinauskas, A.P. Oak Ridge National Lab., TN (USA). 20 Jun 1988. 9p. Sponsored by Environmental Protection Agency; Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. Order Number DE89017494. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The author presented an invited paper entitled "Chemical Considerations in Severe Accident Analysis" at the Symposium on Nuclear Reactor Severe Accident Chemistry which was conducted as part of the Third Chemical Congress of North America. Over 14,000 scientists attended the Congress, representing virtually all of the chemistry disciplines.

52341 (SAND–89-0859) **Flame acceleration studies in the MINIFLAME facility.** Tieszen, S.R.; Sherman, M.P.; Benedick, W.B. Sandia National Labs., Albuquerque, NM (USA). Jul 1989. 33p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE90000041. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Flame acceleration and deflagration-to-detonation transition (DDT) studies have been conducted in a 19.4-cm high, 14.5-cm wide, and 2. 242-m long channel (MINIFLAME) that is a 1:12.6 scale model of the 136-m^3 FLAME facility. Tests were conducted with two levels of hydrogen concentration – 20% and 30%, with and without obstacles in the channel, and with three levels of transverse top venting – 0%, 13%, and 50%. The flame acceleration results in MINIFLAME are qualitatively similar to those in FLAME; however, the small-scale results are more benign quantitatively. The results show that insufficient venting, 13% venting in this case, can promote flame acceleration due to turbulence produced by the flow through the vents in smooth channels. However, with obstacle-generated turbulence in the channel, 13% top venting was found to be beneficial. Flame acceleration resulting in DDT was shown to occur in as little as 35 liters of mixture. Comparison of the DDT data with obstacles in MINIFLAME and FLAME supports d/λ scaling of DDT, where λ is the detonation cell width of the mixture and d is the characteristic open diameter of the channel. In the MINIFLAME and FLAME tests, DDT occurred for d/λ greater than approximately three. Comparison with other experiments shows that the value of d/λ for DDT is not constant but depends on the obstacle type, spacing, and channel geometry. The comparison of MINIFLAME and FLAME experiments extends the use of d/λ scaling to different geometries and larger scales than previous studies. Small-scale-model testing of flame acceleration and DDT with the same combustible mixture as the full-scale prototype underpredicts flame speeds, overpressures, and the possibility of DDT. 18 refs., 16 figs.

52342 Interfacial instabilities leading to bubble departure during film boiling on vertical surface. Wang, S.K. (Argonne National Lab., Argonne, IL (US)); Blomquist, C.A.; Spencer, B.W. pp. 181 of The 5th Miami international symposium on multi-phase transport and particulate phenomena (Condensed Papers). Veziroglu, T.N. Clean Energy Research Inst. University of Miami, Coral Gables, FL (1988). (CONF-881202–: 5. Miami international symposium on multi-phase transport and particulate phenomena, Miami Beach, FL (USA), 12-14 Dec 1988).

An experimental and analytical study has been performed to examine the hydrodynamic breakup and thermal interaction of a corium (molten nuclear-reactor core material) jet injected into water. In order to predict the steam generation and the concomitant system pressurization, a phenomenological model was developed to describe the thermal and hydrodynamic behavior of a high-temperature jet when it interacts with saturated or subcooled water in a film boiling regime. The analytical results were compared with experimental data by Greitzer et al., and the agreement is good. Additionally, this model will suggest a better approach to analyzing film-boiling heat transfer.

52343 Effect of interfacial transfer and wall heat transfer constitutive correlations in a model of PWR ECC bypass. Popov, N.K. (Whiteshell Nuclear Research Establishment, Pinawa, Manitoba (CA)); Rohatgi, U.S. pp. 181 of The 5th Miami international symposium on multi-phase transport and particulate phenomena (Condensed Papers). Veziroglu, T.N. Clean Energy Research Inst. University of Miami, Coral Gables, FL (1988). (CONF-881202–: 5. Miami international symposium on multi-phase transport and particulate phenomena, Miami Beach, FL (USA), 12-14 Dec 1988).

The Emergency Core Cooling (ECC) bypass/refill process in a PWR downcomer, following a postulated large rupture of a cold leg pipe (LOCA), is of particular importance for the PWR thermal-hydraulic safety. In the unlikely event of such accident, due to reactor vessel rapid depressurization and blowdown at the break, coolant flashing and voiding of the reactor core occurs. To prevent fuel assembly overheating, the ECC subcooled water is injected into the reactor vessel. However, instead of penetrating the lower plenum, the ECC water, driven by the steam, flows azimuthally around the core barrel, bypasses through the downcomer and gets expelled out at the break. Mathematical modeling of such complex thermal-hydraulic phenomenon is accompanied with a difficult task of selecting an appropriate set of constitutive correlations. In this paper, using two-dimensional transient diabatic two-phase model of lower plenum ECC refilling and downcomer bypass flow, numerical calculations are performed to study the effect of interphase mass and momentum transfer, and wall heat transfer on lower plenum refilling initiation and rate. The results confirm that the interfacial momentum transfer by interfacial friction has dominant influence on the transient, and that the model is specially sensitive to annular interfacial friction correlation. Considerable difference in refilling predictions was obtained when various annular interfacial friction correlations were assessed in the model. It has been confirmed that with the Popov-Rohatgi correlation, the model refilling predictions are in very good agreement with the experimental data.

52344 The challenge of licensing a reactor with passive safety characteristics. Cunliffe, J.C. (Bechtel National, Inc. (US)); Silady, F.A. vp of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y American Society of Mechanical Engineers, New York, NY (1988). (CONF-880702–: 23. intersociety energy conversion engineering conference, Denver, CO (USA), 31 Jul - 5 aug 1988).

Technical Paper 889153.

Special emphasis has been placed on establishing safety criteria and a safety design philosophy for the Modular High Temperature Gas-Cooled Reactor (MHTGR) which enhances public acceptance while also permitting the presentation of a simple safety case to the regulator. However, the MHTGR safety approach and its characteristics as a gas-cooled reactor move it beyond the existing light water reactor-based regulatory framework. The design selected utilizes an entirely passive decay removal process and ensures inherent safety response to positive reactivity insertion events in order to assure retention of radionuclides by the coated fuel particles even under accident conditions. This obviates the need for a pressure-retaining containment structure and post-accident operator intervention. The challenge for the MHTGR has been to demonstrate its safety capabilities within the existing regulatory regime

while retaining the advantages accruing from its unique inherent characteristics ad passive design features.

52345 **Safety evaluation of the modular high temperature gas-cooled reactor.** King, T.L. (US Nuclear Regulatory Commission (US)). vp of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y American Society of Mechanical Engineers, New York, NY (1988). (CONF-880702–: 23. intersociety energy conversion engineering conference, Denver, CO (USA), 31 Jul - 5 aug 1988).

Technical Paper 889154.

This paper provides a status of NRC's review of the Modular High Temperature Gas-Cooled Reactor (MHTGR). In addition, several factors which influenced the review of the MHTGR are discussed.

52346 **Passive safety and the Advanced Liquid Metal Reactors.** Hill, D.J. (Argonne National Lab., Reactor Analysis and Safety Div., 9700 S. Cass Avenue, Argonne, IL (US)); Pedersen, D.R.; Marchaterre, J.F. vp of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y American Society of Mechanical Engineers, New York, NY (1988). (CONF-880702–: 23. intersociety energy conversion engineering conference, Denver, CO (USA), 31 Jul - 5 aug 1988).

Technical Paper 889074.

Advanced Liquid Metal Reactors being developed today in the USA are designed to make maximum use of passive safety features. Much of the LMR safety work at Argonne National Laboratory is concerned with demonstrating, both theoretically and experimentally, the effectiveness of the passive safety features. The characteristics that contribute to passive safety are discussed, with particular emphasis on decay heat removal systems, together with examples of Argonnes's theoretical and experimental programs in this area.

52347 **MHTGR technology development plan.** Homan, F.J. (Oak Ridge National Lab., Oak Ridge, TN (US)); Neylan, A.J. vp of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y American Society of Mechanical Engineers, New York, NY (1988). (CONF-880702–: 23. intersociety energy conversion engineering conference, Denver, CO (USA), 31 Jul - 5 aug 1988).

Technical Paper 889233.

This paper presents the approach used to define the technology program needed to support design and licensing of a Modular High-Temperature Gas-Cooled Reactor (MHTGR). The MHTGR design depends heavily on data and information developed during the past 25 years to support Large HTGR (LHTGR) designs. The technology program focuses on MHTGR-specific operating and accident conditions, and on validation of models and assumptions developed using LHTGR data. The technology program is briefly outlined, and a schedule is presented for completion of technology work which is consistent with completion of a Final Safety Summary Analysis Report (FSSAR) by 1993.

52348 **Using risk based tools in emergency response.** Dixon, B.W. (EG and G Idaho, Inc., Idaho Falls, ID (US)); Ferns, K.G. pp. 910 of Artificial intelligence and other innovative computer applications in the nuclear industry. Majumdar, M.C.; Majumdar, D.; Sackett, J.I American Nuclear Society, La Grange Park, IL (1987). (CONF-870832–: Topical meeting on artificial intelligence and other innovative computer applications in the nuclear industry: present and future, Snowbird, UT (USA), 31 Aug - 2 sep 1987).

Probabilistic Risk Assessment (PRA) techniques are used by the nuclear industry to model the potential response of a reactor subjected to unusual conditions. The knowledge contained in these models can aid in emergency response decision making. This paper presents requirements for a PRA based emergency response support system to date. A brief discussion of published work provides background for a detailed description of recent developments. A rapid deep assessment capability for specific portions of full plant models is presented. The program uses a screening rule base to control search space expansion in a combinational algorithm.

52349 **Forecasting severe nuclear accidents.** Chow, T.C. Thesis (Ph. D.). 108p. Univ. of California, Berkeley, CA (US) (1987). Available from University Microfilms, PO Box 1764, Ann Arbor, MI 48106, Order No.88-13,832.

The occurrence of severe accidents in commercial nuclear power plants is forecast. A Random Escalation Model (REM) is proposed that uses accident data of both high and low levels of severity to forecast the most-severe ones, which are viewed as escalations of low-severity accidents. Information from safety studies is coherently combined with the data using Bayesian probability theory. REM forecasts are more accurate in the sense that their uncertainties are less than those that only include accidents of the same severity. The special structure of the REM includes other forecasting models such as those derived from the Event-Tree model and the NRC models for accident consequences. By simple manipulation of the influence diagrams of REMs we gain considerable insights and derive two results: A Separable Updating Theorem that allows the parameters of a general REM to be updated in a simple form, and a Level Absorption Theorem that shows that the REM structure is preserved under change in number and classification of levels. Methods of the probabilistic risk analysis adopted by the U.S. Nuclear Regulatory Commission are shown to be asymptotic cases of a consequence model that has the REM structure.

52350 **Preparation of the shippingport reactor pressure vessel shipping package.** Yannitell, D.M. *Transactions of the American Nuclear Society (USA),* 56: 74-75 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The Shippingport Station Decommissioning Project is a US Department of Energy (DOE) project to dismantle the Shippingport Atomic Power Station. One of the more challenging technical aspects of the project, which is being managed for DOE by General Electric Nuclear Energy, is the removal and shipment of the reactor pressure vessel (RPV) and its associated neutron shield taken (NST) to the government-owned Hanford Reservation in Richland, Washington. The paper presents a description of the RPV and discusses disposal alternatives, regulations, package preparation, and final RPV package description. This is the first application of one-piece removal and barge transport of an irradiated nuclear RPV. Its potential application to future decommissionings may provide significant cost, schedule, and person-rem savings over the more conventional segmentation methods.

52351 **Removal and transportation of the reactor pressure vessel/neutron shield tank package.** Coughlin, P.J. *Transactions of the American Nuclear Society (USA),* 56: 75-76 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The Shippingport Station Decommissioning Project is a US Department of Energy sponsored project to dismantle the Shippingport Atomic Power Station (SAPS) and return the government-leased property in a radiologically safe condition to its owner, Duquesne Light Company. One key feature of the project includes the removal of the reactor pressure vessel/neutron shield tank (RPV/NST) package from its existing location at SAPS and its transportation by barge to the government-owned Hanford Reservation in Richland, Washington. The package, which consists of the RPV, its non-fuel-bearing internals, and the integral NST, will be prepared as a monolithic metal/concrete package for shipment. The package, which is ≈5.1 m in diameter by 12 m in length with a gross weight of ≈907 tonnes, will contain ≈16,000 Ci of radioactivity and have a surface contact radiation exposure rate of ≈2 mrem/h. The package is currently located ≈19 m below grade in the reactor enclosure. A description of the three major operations necessary to deliver the RPV package to the Hanford burial site is presented. These are: (1) heavy lifting, land transportation, and barge loading, barge transportation, and Hanford transportation. This work will be the first use of barge transportation in the United States of a radioactive RPV package from a decommissioned land-based nuclear power plant.

52352 **Implementation of site-release criteria at Shippingport.** Eger, K.J.; Galgoul, M.J.; Carr, J.B. *Transactions of the American Nuclear Society (USA),* 56: 76-78 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Criteria for the unconditional release of the site and materials left thereon following decommissioning of the Shippingport Atomic Power Station (SAPS) site were issued by the US Department of Energy (DOE) in January 1987. The criteria were 100 mrem/year

vial the worst-case scenario and as low as reasonably achievable (ALARA). Subsequently, General Electric Nuclear Energy, the decommissioning operations contractor (DOC), generated a final consolidated implementation plan. This document defined the scenarios by which the final dose would be calculated, the limiting conditions for the as-decommissioned site, and the methodology for demonstrating the achievement of these conditions. The plan is being used concurrently with the decommissioning operations to demonstrate that the site will meet the criteria issued.

52353 Decontamination to achieve site-release criteria. Schulmeister, A.R. *Transactions of the American Nuclear Society (USA),* 56: 78-79 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The Shippingport Station Decommissioning Project presented unique opportunities in the management and performance of component and area decontamination to meet established site-release criteria. Decontamination activities were performed to meet the following overall project objectives: (1) internal decontamination of radioactively contaminated components to meet low-specific-activity (LSA) shipping limits, (2) reduction of component radiation levels to as low as reasonably achievable (ALARA) for subsequent dismantlement, packaging, and off-site disposal, (3) reduction of surface contamination to qualify steel structurals for unrestricted off-site release, and (4) reduction of surface contamination to qualify concrete structurals for unrestricted on-site release. The paper discusses planning and scheduling decontamination activities, surface decontamination methods and techniques, and internal component decontamination methods and techniques. Successful completion of the decontamination activities at Shippingport has demonstrated that state-of-the-art technology can by applied cost-effectively to support a full-scale nuclear power plant decommissioning.

52354 Surface decontamination utilizing mechanical vacuum blasting methods. McKernan, M.L.; Schulmeister, A.R. *Transactions of the American Nuclear Society (USA),* 56: 79-81 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

As part of the Shippingport Station Decommissioning Project (SSDP) surface decontamination effort, vacuum blasting techniques were utilized to remove fixed radioactive contamination entrained in steel and concrete painted surfaces to meet on-site and off-site release limits. Removal of contaminated paint by vacuum blasting was restricted to selected areas of the project. Specifically, this technique was applied only when it was determined to be cost-effective compared to other methods of paint removal or direct disposal of the bulk material as contaminated waste. As the lower portions of the reactor plant container painted steel surface was eligible for this surface decontamination technique. A performance summary of the results obtained using vacuum blasting is included. Based on these results, it is concluded that application of vacuum blasting techniques was effective in terms of removal rate, person-hours expended, and waste generated.

52355 Shippingport: A relevant decommissioning project. Crimi, F.P. *Transactions of the American Nuclear Society (USA),* 56: 72-74 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The nuclear steam supply system of the Shippingport Atomic Power Station is a four-loop, 72-MW(electric) pressurized water reactor. The reactor plant and associated systems are owned by the U.S. Department of Energy. The 100-MW(electric) turbine-generator and balance of plant are owned by the Duquesne Light Company and are not part of the decommissioning scope of work. The station is located at Shippingport, Pennsylvania, on 7 acres of land leased until 1994 by DOE from DLCo. Defueling of the nuclear reactor was completed early September 1984, and the DOE portion of the station is now being decommissioned by General Electric Nuclear Energy under contract to the DOE. As of December 31, 1987, the Shippingport Station Decommissioning Project (SSDP) was ≈70% complete and was ahead of schedule and under budget. The main objectives of the SSDP are to (1) demonstrate the safe and cost-effective dismantlement of a large-scale nuclear power plant, and (2) provide useful data for the future decommissioning of commercial nuclear power plants. Reactor pressure vessel, steam generators, pressurizer, reactor coolant pumps, and other features are discussed specifically in the paper.

52356 Silver-indium-cadmium control rod behavior in severe reactor accidents. Petti, D.A. (Idaho National Engineering Lab., Idaho Falls, ID (USA)). *Nuclear Technology (USA),* 84(2): 128-151 (Feb 1989).

Silver-indium-cadmium (Ag-In-Cd) control rod behavior in severe reactor accidents is examined with a goal of improving the methodology used to estimate reactor accident source terms. Control rod behavior in both in-pile and out-of-pile experiments is reviewed. A mechanistic model named VAPOR is developed that calculates the downward relocation and simultaneous vaporization behavior of the Ag-In-Cd alloy expected after control rod failure in a severe reactor accident. VAPOR is used to predict the release of silver, indium, and cadmium vapors expected in the Power Burst Facility (PBF) severe fuel damage (SFD) 1-4 experiment. In addition, a sensitivity study is performed to examine the effects of system pressure and flow rate on control rod vapor release. Although cadmium is found to be the most volatile constituent of the alloy, all of the calculations predict that the rapid relocation of the alloy down to cooler portions of the core results in a limited release for all three control rod alloy vapors. Results of the control rod and aerosol behavior in PBF and SFD 1-4 are presented.

52357 Analysis of the source range monitor during the first four hours of the Three Mile Island Unit 2 accident. Wu, H.Y. (Institute of Nuclear Energy Research, Lungtan (TW)); Hsiao, M.Y.; Baratta, A.J.; Bandini, B.R.; Tolman, E.L. *Nuclear Technology (USA),* 84(2): 169-181 (Feb 1989).

The source range monitor (SRM) data recorded during the first 4 h of the Three Mile Island Unit 2 (TMI-2) accident following reactor shutdown were analyzed. An effort to simulate the actual SRM response was made by performing a series of neutron transport calculations. Primary emphasis was placed on simulating the changes in SRM response to various system events during the accident so as to obtain useful information about core conditions at the various stages. Based on the known end-state reactor conditions, the major system events and the actual SRM readings, self-consistent estimates were made of core liquid level, void fraction in the coolant, and locations of core materials. This analysis expands the possible interpretation of the SRM data relative to core damage progression. The results appear to be consistent with other studies of the TMI-2 Accident Evaluation Program, and provide information useful for the development and determination of the TMI-2 accident scenario.

52358 CATALisp - an expert system for real-time diagnosis of multiple-failure transients in pressurized water reactors. Martin, R.P. (Texas A & M Univ., College Station (USA)); Nassersharif, B. *Transactions of the American Nuclear Society (USA),* 56: 280-281 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The state of the art in artificial intelligence (AI) and expert system (ES) technology has matured to a degree that the potential development of a computer-aided/automated diagnostic and transient mitigation system in the area of nuclear reactor operation can be considered. Since traditional methods cannot handle complex systems efficiently, AI techniques provide a means to emulate an expert reactor operator rather than follow mechanistic methods. Computer-aided transient analysis coded in LISP (CATA-Lisp) is a confidence level based expert system written in Common LISP on the SYMBOLICS 3640 computer system. New versions are being developed in Common LISP for the Texas Instruments (TI) Explorer and the Sun microsystems machines, CATALisp manipulates both a knowledge base of transient identifier patterns (tree structured to allow for zooming in diagnostics) and a knowledge base containing a qualitative model of a nuclear power plant. The interference engine used by CATALisp uses the information stored in both knowledge bases to arrive at confidence level values that are used to infer particular plant states.

52359 Systematic generation of rules for nuclear power plant diagnostics. Reifman, J.; Lee, J.C. *Transactions of the American Nuclear Society (USA),* 56: 281-282 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The knowledge base of an expert system is generally represented by a set of heuristic rules derived from the expert's own experience and judgmental knowledge. These heuristic or production rules are cast as if (condition), then (consequence) statements, and represent, for nuclear power plant diagnostic systems, information connecting symptoms to failures. In this paper, the authors apply an entropy minimax pattern recognition algorithm to automate the process of extracting and encoding knowledge into a set of rules. Knowledge is extracted by recognizing patterns in plant parameters or symptoms associated with failures or transient events, and is encoded by casting the discovered patterns as production rules. The paper discusses how the proposed method can systematically generate rules that characterize failure of pressurizer components based on transient events analyzed with a pressurizer components based on transient events analyzed with a pressurizer water reactor simulator program.

52360 **Vapor condensation on aerosols: Numerical simulation.** Park, J.W. (Univ. of Missouri, Columbia (USA)); Loyalka, S.K. *Transactions of the American Nuclear Society (USA),* 56: 287-288 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Vapor/gas condensation and evaporation from particles (liquid/solid) play an important role in nuclear reactor thermal hydraulics and source term estimations. The reactor safety analysis codes model this process using a variety of phenomenological descriptions and numerical techniques. The authors have recently constructed a new model for condensation, and have provided some benchmark results that can be used for assessment of accuracy of various popular numerical techniques of solving the relevant aerosol evolution equation. It is the purpose here to describe some results of this assessment. Also offered are a few suggestions that should be helpful in improving the modeling efforts.

52361 **Nuclear criticality safety tools in the Chernobyl-4 accident analysis.** Landeyro, P.A. *Transactions of the American Nuclear Society (USA),* 56: 315-316 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The collaboration with the Italian Safety Authority (DISP), started in July 1986, has the aim of studying, from a neutronic point of view, the possible initiator event and the accident dynamics in unit four of the Chernobly nuclear power plant. This report was produced within the framework of that collaboration. A main condition of the present work was making use of standard calculational methods employed in nuclear criticality safety analysis. This means that the neutron multiplication factor calculation should be made with the modules and the cross-section libraries of the SCALE system or in any case with some KENO IV version and the burnup calculation with the ORIGEN code.

25 ENERGY STORAGE

52362 (NEDOJ–8809, pp. 291-295) **Outline of fuel/storage technology development.** Tagawa, Shigeo (New Energy Development and Industrial Technology Organization, Tokyo (Japan)). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the 8th NEDO General Assembly.* Available from NTIS (US Sales Only), PC A23/MF A01.

4 projects, Fuel Cell Power Generation Technology, New Type Battery Power Storage System, Superheat Pump Energy Storage System and General Purpose Stirling Engine, were carried on in 1987 as a part of the Moonlight Project. Development of ceramic gas turbine will start in 1988. Power generation system covering a wide range of application will be studied in which natural gas, methanol, coal gas, etc. can be used as the fuel. Electric power storage system with load leveling ability shall be developed as the new type battery storage system. In the area of the general purpose stirling engine, 3kW and 30kW class engines will be studied and developed for the verification of their practical application. Super heat pump energy storage system will be developed which chemically stores heat using electric power during the night. Aiming at the improvement of small-to-medium type engines for higher efficiency, pollution reduction, and use of variety of fuels, ceramic gas turbines shall be stuidied and devloped.

2501 Magnetic

52363 **Design and optimization of hydrogen cooled pulsed storage inductors for electromagnetic launchers.** Eyssa, Y.M. (Wisconsin Univ., Madison, WI (USA). Applied Superconductivity Center); Abdelsalam, M.K.; Boom, R.W.; Huang, X.; McIntosh, G.E.; Waynert, J. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics (USA),* 25(1): 174-179 (Jan 1989).

Cryoresistive magnetic energy storage systems that can deliver Meg-Amp Kilo-Volt levels of pulsed power for a short time (200-1000 s) have important potential applications in space-based strategic defense systems. Hydrogen cooled aluminum cryoresistive coils operating at frequencies > 1 H_z are efficient and light weight ($_{\Delta}$E/M = 20-50 J/g). In this paper the authors report on: analysis of eddy current losses; the use of aluminum inductors at $15 K < T < 30 K$ in fields $B < 10$ T; inductor cooling; optimization of energy stored per unit mass; and conceptual designs of 300 MJ hydrogen cooled cryoresistive toroids and solenoids.

2506 Thermal

52364 (ORNL/TM–11233) **Thermal energy storage: Technical progress report, April 1987–March 1988.** Tomlinson, J.J.; Kedl, R.J. Oak Ridge National Lab., TN (USA). Sep 1989. 48p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90000953. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Progress in the development of thermal energy storage (TES) technology under Oak Ridge National Laboratory's TES Program for the period April 1987 to March 1988 is reported. Program goals and project structures are presented. Each of the projects active during this report period is discussed, and the contribution of specific projects to major technology transfer activities is described. 14 refs., 21 figs., 3 tabs.

2509 Batteries

Refer also to citation(s) 52105

52365 (AD-A–209098/3/XAB) **Effect of niobium doping on the properties of molybdenum sulfides as cathode materials.** Dunn, B.; Shin, H.; Doerr, H.J.; Despandey, C.; Fuqua, P. California Univ., Los Angeles, CA (USA). School of Engineering and Applied Science. 1988. 8p. Available from NTIS, PC A02/MF A01.

Pub. in Surface and Coatings Technology, Vol. 36, 859-865(1988).

Poorly crystalline molybdenum sulfides are promising candidates as cathode materials which require good electronic and ionic conductivity. Poorly crystalline molybdenum sulfide films with a large range of sulfur contents were successfully synthesized by the activated reactive evaporation technique. Raman spectra of the poorly crystalline films showed dual structure characteristics corresponding to ^{2}H-MoS_2 and amorphous MoS_3. The films with the above structure demonstrated significantly improved intercalation ratios of lithium atoms, thereby enhancing the energy density of the secondary lithium batteries. However, the current density was lower because of the high electronic resistivity of the films. Niobium, acting as an acceptor, was, therefore, doped into the molybdenum sulfide films to decrease the electronic resistivity. Decrease in the resistivity by about three orders of magnitude was observed.

52366 (CONF-891132–Summs.) **Extended abstracts: Ninth battery and electrochemical contractors' conference.** Synergic Communication Services, Inc., Columbus, OH (USA); Battelle Pacific Northwest Lab., Richland, WA (USA). Nov 1989. 332p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC06-76RL01830. From 9. battery and electrochemical contractors' conference; Alexandria, VA (USA); 13-17 Nov 1989. Order Number DE89016837. Available from NTIS, PC A15/MF A01 - OSTI; GPO Dep.

This document contains the extended abstracts for presentations scheduled for the Ninth Battery and Electrochemical Contractors'

Conference, highlighting research supporting by the US Department of Energy and the Electric Power Research Institute. It is intended to be a technical overview for engineers and scientists in government, industry, and academia who are interested in learning more about electrochemical energy storage. The abstracts are grouped according to the following technical sessions: Introductory Session; Sodium/Sulfur Battery Development; Planning, Analysis, and Technology Transfer; Fuel Cells; Zinc/Bromine Battery Development; Aqueous Battery Development; Non-Aqueous Batteries; Battery Testing and Evaluation; and Metal/Air Batteries.

52367 (LBL–27593) **Novel high-rate, all solid-state, sodium and lithium/organosulfur batteries.** Visco, S.J.; Liu, Meilin; Armand, M.B.; De Jonghe, L.C. Lawrence Berkeley Lab., CA (USA). Aug 1989. 4p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. (CONF-891132–6: 9. battery and electrochemical contractors' conference, Alexandria, VA (USA), 13-17 Nov 1989). Order Number DE90001014. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper is an abstract for a talk to be given at the Battery and Electrochemical Contractor's Conference. The paper gives a brief description of sodium and lithium/organosulfur batteries. (JEF)

52368 (SAND–89-1852C) **Zinc/bromine battery evaluation at SNL [Sandia National Laboratory].** Lott, S.L.; Butler, P.C.; Freese, J.M. Sandia National Labs., Albuquerque, NM (USA). 1989. 6p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. (CONF-891132–1: 9. battery and electrochemical contractors' conference, Alexandria, VA (USA), 13-17 Nov 1989). Order Number DE89015847. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Three prototype zinc/bromine batteries were evaluated a Sandia during the last year. The objectives of these tests were to determine performance, cycle life, durability of the auxiliary components, and failure mechanisms. All three were deliverables from a Sandia development contract with Energy Research Corporation (ERC). The test results were communicated to ERC along with suggestions for improving battery design and reliability. 3 figs., 2 tabs.

52369 (SAND–89-1886C) **Sodium/sulfur evaluation at SNL.** Freese, J.M. Sandia National Labs., Albuquerque, NM (USA). [1989]. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-891132–3: 9. battery and electrochemical contractors' conference, Alexandria, VA (USA), 13-17 Nov 1989). Order Number DE89015846. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Sandia National Laboratories (SNL) has been involved in the evaluation of the sodium/sulfur technology for several years. Until recently, the effort concentrated on the performance of single cells. Recently, the evaluation of 4-cell string was initiated. The majority of the activity during the past two years has focused on cells from Chloride Silent Power, Limited (CSPL). To date, four groups of PB cells and 4-cell strings, which consisted of PB cells, have been evaluated. The first group of ten cells delivered to Sandia were on test for approximately one year. The majority of these cells failed due to corrosion problems in the sulfur seal. However, two cells completed over 800 cycles, and one of these cells completed nearly 1600 cycles. 4 figs., 1 tab.

52370 (SAND–89-1914C) **Membrane and durability studies for the zinc/bromine battery.** Arnold, C. Jr.; Assink, R.A.; Butler, P.C. Sandia National Labs., Albuquerque, NM (USA). [1989]. 7p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. (CONF-891132–4: 9. battery and electrochemical contractors' conference, Alexandria, VA (USA), 13-17 Nov 1989). Order Number DE89016181. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Zinc/bromine flow batteries are being developed for vehicular and utility load leveling applications by Johnson Controls Co. and Energy Research Corp. under DOE sponsorship. Problems that have been encountered with the zinc/bromine battery are loss of coulombic efficiency brought about by permeation of bromine through the separator and limited life caused by attack of the bromine-containing electrolyte on plastic parts, particularly the flow frame. In this paper, we show that large decreases in the bromine transport rates through microporous separators can be achieved with only a minimal loss of conductivity and identify a chemically stable replacement for PVC, a flowframe material. 4 figs., 1 tab.

52371 (SAND–89-7103C) **Terrestrial nickel/hydrogen battery development at Johnson Controls, Inc.** Beauchamp, R.L.; Zagrodnik, J.P. Sandia National Labs., Albuquerque, NM (USA). [1989]. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-891132–2: 9. battery and electrochemical contractors' conference, Alexandria, VA (USA), 13-17 Nov 1989). Order Number DE89015843. Available from NTIS, PC A02/MF A01 - OSTI.

This paper is a very brief summary of the life cycle cost and efficiency of the nickel-hydrogen battery to be used with photovoltaic charging. (JEF)

52372 **In-situ electrolyte storage for batteries.** Tarcy, G.P. To Aluminum Co. of America, Pittsburgh, PA. USA Patent 4,842,964. 27 Jun 1989. Filed date 21 Mar 1988. vp Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a reserve battery which has long-term in-situ storage of electrolyte including a housing, an anode, a cathode. The anode and the cathode are disposed in relative spaced relationship within the housing, an interelectrode space being defined by the anode and cathode. The improvement consists of: a sealed container composed of an elastomeric material; the sealed container being disposed in the housing; the sealed container containing a sufficient amount of electrolyte to effect activation of the battery when brought into contact with the anode and the cathode; and fracturing means for releasing the electrolyte from the sealed container, whereby when the fracturing means breaks the sealed container electrolyte floods the inter-electrode space.

29 ENERGY PLANNING AND POLICY

Refer also to citation(s) 52467, 52468

2901 Energy Analysis and Modeling

Refer also to citation(s) 52049, 52409

2902 Economics and Sociology

Refer also to citation(s) 52386, 52387, 52388, 52389, 52418, 52470, 53601

52373 (CONF-8909200–1) **Adaptability in chemical engineering.** Watson, J.S. Oak Ridge National Lab., TN (USA). 1989. 22p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Workshop on national priorities and technological change: fostering flexibility in the engineering work force; Washington, DC (USA); 29 Sep 1989. Order Number DE90000709. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The adaptability issue for chemical engineering (the ability of chemical engineers to be retrained to work in other fields and for those from other fields to be retrained for work in chemical engineering) will be discussed and illustrated in terms of (1) the interdisciplinary origin of chemical engineering; (2) similarities of chemical engineering curricula with those of other professions; (3) the expected future directions of chemical engineering which are likely to include greater involvement of interdisciplinary skills and, perhaps, greater adaptability; and (4) a few actions that could enhance adaptability. Few quantitative facts are presented in this paper, but a brief section suggests ways to quickly gain limited quantitative information on adaptability. 5 refs., 2 tabs.

52374 (LBL–26260, pp. 12.1-12.17) **The role of coal in the US energy economy: interfuel competition, environmental concerns, and the impact of utility restructuring.** Raschke, M.G. Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA); Analysas Corp., Oak Ridge, TN (USA). Nov 1988. (CONF-8806261–: Chinese/American symposium on energy markets and the future of energy demand, Nanjing (China), 22-24 Jun 1988). In *Proceedings of the Chinese-American symposium on energy markets and the future of energy demands.* Order Number DE89012862. Available from NTIS, PC A12/MF A01.

This paper briefly examines the role coal plays in the US energy economy and its competition with nuclear power, and then in greater detail the impact of environmental regulation, changes in utility regulation, and inter fuel competition on the future of coal. The US as the world's number two coal producer, shares many of the same problems and concerns as China, the world's number one coal producer. The use of coal in electric generation has been and will continue to be the only growth sector for the coal industry. The steel industry remains in permanent long-term decline. Forecasts vary, but there are indications that even in conservative forecasts, there is more down side risk than upside potential. Poor performance in the nuclear power sector can be expected to favorably impact coal consumption in the long term. Continued escalation of operating costs could erode any cost advantage that nuclear plants currently enjoy. However, environmental concerns could also escalate operating costs for coal fired plants. Also, concern over the greenhouse effect may lead policy makers to reexamine the nuclear option of inherently safe reactors. The greatest challenge to expanded use of coal comes from environmental concerns. Acid rain is a complex political, economic, and scientific issue. Clean coal technologies are seen by many as the answer to the threat posed by various forms of clean air legislation and regulation. Significant changes in the regulatory environment for electric and gas utilities and technological developments are likely in the 1990's to alter the nature of the electric generation industry.

52375 (PB–89-198667/XAB) **Ridesharing and transportation for the disadvantaged. Transportation research record.** Lauritzen, T.; McKelvey, F.X.; Lyles, R.W.; Lighthizer, D.R.; Hardy, D.K. National Research Council, Washington, DC (USA). Transportation Research Board. 1988. 97p. (TRB/TRR–1170). Available from NTIS, PC A05/MF A01.

Library of Congress catalog card No. 88-38477.

The 11 papers in the report deal with the following areas: a 1-year review of performance measures for the Chicago transit authority's special services contracted service for the elderly and handicapped; evaluation of a demonstration small bus program for the elderly and handicapped; travel mode choice behavior and physical barrier constraints among the elderly and handicapped: an examination of travel-mode preferences; the role of private enterprise in elderly and handicapped transportation in Canada; special transportation-service in Sweden–involvement of private operators; role of the private sector in the delivery of transportation services to the elderly and handicapped in the United States; suburban activity center transportation demand management market research study; commuting behavior of Hawaii state workers in Honolulu: implications for transportation system management strategies; mobility and specialized transportation for elderly and for disabled persons: a view from four selected countries; an inventory of twelve paratransit service delivery experiences; integrating social-service client transportation and special needs transportation systems: the Portland experience.

52376 (PB–89-202188/XAB) **Transportation in an aging society: improving mobility and safety for older persons. Volume 1. Committee report and recommendations. Special report.** National Research Council, Washington, DC (USA). Transportation Research Board. 1988. 139p. (TRB/SR–218-VOL-1). Available from NTIS, PC A07/MF A01.

See also Volume 2, PB–89-202196.

In June 1986, the Transportation Research Board began a project to investigate the needs and problems of older Americans in relation to the U.S. roadway-transportation system. A committee of experts was appointed to review the design and operational features of the roadway system and to recommend steps to improve the mobility and safety of older users–drivers, passengers, pedestrians–who are an integral part of the system. The committees found that people over the age of 75 are involved in more fatal crashes than any other group except teenagers. Nevertheless they decided that 'age alone is a poor predictor of the performance of any individual.' Rather than restricting licenses at any given maximum age, the committee recommended that highway safety be improved by making adjustments to the design of highway features and that license screening tests be adapted to better identify people of all ages who have impairments that would affect driving. The committee also recommended improved specialized transportation for the frail elderly.

52377 (PB–89-202196/XAB) **Transportation in an aging society: improving mobility and safety for older persons. Volume 2. Technical papers. Special report.** National Research Council, Washington, DC (USA). Transportation Research Board. 1988. 419p. (TRB/SR–218-VOL-2). Available from NTIS, PC A18/MF A01.

See also Volume 1, PB–89-202188.

In June 1986, the Transportation Research Board began a project to investigate the needs and problems of older Americans in relation to the U.S. roadway transportation system. A committee of experts was appointed to review the design and operational features of the roadway system and to recommend steps to improve the mobility and safety of older users–drivers, passengers, pedestrians–who are an integral part of the system. The committee recommended that highway safety be improved by making adjustments to the design of highway features and that license screening tests be adapted to better identify people of all ages who have impairments that would affect driving. The committee also recommended improved specialized transportation for the frail elderly.

2903 Environment, Health, and Safety

Refer also to citation(s) 51653, 51770, 52049, 52276, 52374, 52391, 52392, 52394, 52395, 52456, 52457, 52489, 52490, 52497, 52507, 53136, 53150, 53165, 53211, 53213, 53214, 53215, 53216, 53232, 53247, 53248, 53269

52378 (DOE/EH–0098) **Program appraisal of radiological protection at the Martin Marietta Energy Systems Oak Ridge complex.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (USA). Sep 1989. 212p. Sponsored by U.S. DOE Environment Health & Safety. Order Number DE90000864. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

This report presents the results of a special Radiological Protection Program Appraisal (RPPA) which was commissioned by the Deputy Assistant Secretary for Safety, Health, and Quality Assurance (DAS/SHQA) to assess the technical aspects of the radiation protection and safety program for the Oak Ridge complex. The three sites appraised, viz, the Oak Ridge National Laboratory (ORNL), the Y-12 Plant, and the Oak Ridge Gaseous Diffusion Plant (ORGDP) are operated by Martin Marietta Energy Systems, Inc. (MMES). The appraisal was conducted July 11–14, 1989, and July 24–August 4, 1989, and a draft copy of the report was provided to the Oak Ridge Operations Office and MMES at the close-out briefing on August 4, 1989.

52379 (PB–89-208144/XAB) **Toxics-release inventory: A national perspective, 1987.** Environmental Protection Agency, Washington, DC (USA). Office of Toxic Substances. Jun 1989. 349p. (EPA–560/4-89/005). Available from NTIS, PC A15/MF A01.

Also available from Supt. of Docs. See also PB–89-208151.

The 1987 Toxics Release Inventory was mandated by the 'Emergency Planning and Community Right-to-Know Act' enacted by Congress in October of 1986. The law, also known as Title III of the Superfund Amendments, is based on the premise that citizens have a 'right-to-know' about toxic chemicals in their communities, and has two main purposes: to encourage planning for response to chemical accidents; and to provide the public and the government information about possible chemical hazards in their communities. The law requires States to establish State Emergency Response Commissions and Local Emergency Planning Committees to collect detailed information of local manufacturers. The law further requires certain manufacturers to report to the U.S. Environmental Protection Agency (EPA) and to States the amounts of over 300 toxic chemicals that they release directly to air, water, or land, or that they transport to off-site facilities. In addition, the law specifies that the EPA must compile these reports into an annual inventory of releases and transfers, the Toxics Release Inventory (TRI), and make the inventory available to the public in a computerized database. The report summarizes release and transfer data for 1987, the first year of data collection under TRI.

52380 (PB–89-208151/XAB) **Toxics-release inventory. Executive summary.** Hampshire Research Associates, Alexandria, VA

(USA). Jun 1989. 29p. (EPA–560/4-89/006). Available from NTIS, PC A03/MF A01.

See also PB–89-208144.

This report highlights the full National Report which gives detail on the release of chemicals to land, air and water. The summary includes graphs and maps to make the report both easy to understand and very informative.

52381 (PB–89-213169/XAB) **RCRA (Resource Conservation and Recovery Act) orientation manual.** Knox, R.; McDonough, B.S.; Dolin, E.J. Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste. Jan 1986. 168p. (EPA–530/SW-86/001). Available from NTIS, PC A08/MF A01.

Also available from Supt. of Docs.

This manual explains the RCRA program. Although the manual was designed for EPA and State staff, the authors hope that it will be useful to all individuals who wish to better understand RCRA. The manual is written for those unfamiliar with the RCRA program, therefore complex details were either simplified or excluded for the sake of clarity. Each chapter of the manual includes an overview of what is to be covered, illustrations and figures highlighting the text, and a summary of the key points presented.

52382 (PB–89-215883/XAB) **Jacks Creek wilderness environmental impact statement. Final report.** Bureau of Land Management, Boise, ID (USA). Boise District Office. 1989. 389p. Available from NTIS, PC A17/MF A01.

Also available from Supt. of Docs.

The Proposed Action recommends 99,605 acres suitable for wilderness designation and 77,692 acres nonsuitable for wilderness. One state-owned 604-acre inholding within the Duncan Creek WSA is included in this suitable acreage. These lands are located in seven wilderness study areas (WSAs) in southwestern Idaho's Owyhee County, 60 to 100 miles south of Boise, Idaho. The document analyzes the environmental consequences of the proposal and alternatives ranging from no wilderness to all wilderness for each WSA. The seven WSAs considered in this document are given in the report.

52383 (PB–89-864789/XAB) **Best demonstrated available technology (BDAT) for pollution control and waste treatment. January 1976-July 1989 (Citations from the NTIS data base). Report for January 1976-July 1989.** National Technical Information Service, Springfield, VA (USA). Aug 1989. 115p. Available from NTISPC N01/MF N01.

This bibliography contains citations concerning the most current equipment and processes for pollution control and waste treatment that attempt to meet the guidelines set by the Environmental Protection Agency (EPA). Technology for pollution control and waste treatment used by the EPA to develop current effluent standards, and pollution control methods used by industry to meet those standards are considered. Standards for gaseous, liquid, and solid pollution are discussed. BDAT (Best Demonstrated Available Technology) is an acronym for best currently available technology as defined by the EPA. (Contains 199 citations fully indexed and including a title list.)

52384 (POEF–2006) **Long-Range Environmental and Waste Management Plan, fiscal years 1989–1995.** Martin Marietta Energy Systems, Inc., Piketon, OH (USA). Sep 1989. 423p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC05-76OR00001. Order Number DE90001387. Available from NTIS, PC A19/MF A01 - OSTI; GPO Dep.

This report, The Portsmouth Long-Range Environmental and Waste Management Plan, is the annual update in a series begun at this installation in fiscal year 1985. The primary purpose of this report is to provide a thorough and systematic planning document to reflect the continuing process of site assessment, strategy development and planning for the current and long-term control of environmental issues, waste management practices, and remedial action requirements. The document also provides an estimate of the resources required to implement the current plan. This document is not intended to be a budget document but a tool to provide guidance to both Energy Systems and Department of Energy as to the order of magnitude of the resources (primarily funding requirements) and the time frame required to execute the strategy in the present revision of the plan. As with any document of this nature, the near-term (one to three years) part of the plan is a realistic assessment of the current program and ongoing capital projects and reflects the efforts perceived to be necessary to comply with all current state and federal regulations and DOE Orders. It also should be in generally good agreement with current budget (funding) requests and obligations for these immediate years. Beyond the immediate time frame, the document reflects the strategy and the project and funding estimates as a snapshot at the time of publication.

2904 Natural Resources

Refer also to citation(s) 52496, 53211, 53280, 53283

52385 (PB–89-202782/XAB) **Indicators for assessing changes in natural resources in developing countries.** McCracken, R.J. Agency for International Development, Washington, DC (USA). 1988. 59p. Available from NTIS, PC A04/MF A01.

The sustainability of the natural-resource base is being seriously threatened in many developing countries by local efforts to meet basic needs for food, fiber, and fuelwood. This paper suggests eight illustrative indicators for assessing the impact of A.I.D. agricultural and forestry projects on natural resources: soil-productivity maintenance, land use and management, vegetative cover and plant health, agroforestry and fuelwood supply, rangeland conditions and trends, water supply, environmental quality, and accelerated general degradation processes. Appendices cover procedures, data items, and costs for natural resource inventories in the United States; Geographic Information Systems (GIS) with digitized map information; costs of soil surveys, digitized maps, and GISs; estimated costs for remote sensing of natural resources; and a U.S. Department of Agriculture water erosion prediction project being developed to replace the universal soil loss equation. Includes a 5-page bibliography.

52386 (PB–89-202832/XAB) **A.I.D.'s (Agency for International Development's) experience with rural development: Project-specific factors affecting performance. Special study.** Binnendijk, A. Agency for International Development, Washington, DC (USA). Center for Development Information and Evaluation. Jan 1989. 57p. (AID-EVALUATION-SS–60). Available from NTIS, PC A04/MF A01.

See also PB–88-217088.

This paper describes some of the Agency for International Development's experiences with rural-development projects. Discussion is restricted to project-related factors that have been found to influence rural-development project performance, defined in terms of project effectiveness, development impacts, and sustainability. Only factors usually considered within the control of project management or the donor agency are included, such as choices about management strategies and organizational structures, appropriate technologies, and project design, monitoring, and evaluation approaches.

52387 (PB–89-204002/XAB) **Effects of economic growth, technology change, consumption pattern change, and foreign trade on domestic demand for primary metals, 1963-82. Open File report.** Devine, P.R. Bureau of Mines, Washington, DC (USA). Div. of Policy Analysis. Dec 1988. 136p. (BUMINES-OFR–24-89). Available from NTIS, PC A07/MF A01.

This report is based upon an interindustry analysis from 1963 through 1982, during which time U.S. metals consumption and production did not keep pace with economic growth. The report discusses three sources of change: economic growth, technological change, and composition of final demand, as well as the relative importance of the individual components of final demand for metals. The results show investment and personal consumption to be the most metal-intensive components of final demand, and technological change to be the major cause of decline in consumption growth during the study period. A trade analysis shows the significance of import growth, particularly indirect imports (metal contained in imported goods) as a factor contributing to the reduced growth rate of domestic metal production. The effect of import growth is partially offset by indirect export growth, suggesting that continued increase of all U.S. exports can have a strong effect in reducing the negative trade balance in metals.

52388 (PB–89-204325/XAB) **Contribution of forestry to economic development, with special reference to employment and income in developing countries: An annotated bibliography. Working paper.** Basu, R.; Johnson, T.G. Southeastern Center for Forest Economics Research, Research Triangle Park, NC (USA). Forestry Private Enterprise Initiative Project. Jan 1988. 115p. (FPEI-WP–31). Available from NTIS, PC A06/MF A01.

The role of industrial forestry in promoting rural employment and income generation is the focus of the annotated bibliography, which cites 82 papers, most dating from the period 1970-86. The annotations note the economic, environmental, policy, and administrative issues treated in the papers. Author, country, and keyword indexes are included, along with a sampling of the articles rejected from the bibliography. The literature suggests that forestry offers an extraordinary opportunity for rural economic development in developing countries, especially by providing an opportunity to use otherwise erodable, low-valued land to create valuable products for rural use. Forestry can also help to diversify rural economies, create employment opportunities for part-time farmers, provide incentives against rural-urban migration, and produce-needed foreign exchange.

52389 (PB–89-204341/XAB) **Guide to investment and trade in the forest-product sectors of Southeast Asia: Indonesia, Malaysia, and the Philippines. Working paper.** Krutilia, K. Southeastern Center for Forest Economics Research, Research Triangle Park, NC (USA). Forestry Private Enterprise Initiative Project. Jan 1988. 198p. (FPEI-WP–32). Available from NTIS, PC A09/MF A01.

Declining timber resources, an increase in value-added wood-base processing, new export markets, and a growing stress on joint ventures have been key factors in the rapid evolution since 1975 of Southeast Asia's forest products industry. The report profiles the industry and its prospects in Indonesia, the Philippines, and Malaysia, each of which differs with respect to stage of wood-industry development and investment climate. The countries' forest management policies, timber resources, and the status of their wood-based processing industries are reviewed first, followed by an overview of the business environment in each country, the latter covering policies toward foreign investment (including the increasingly important investments from other less-developed countries), investment licensing and regulation, taxation, exporting/importing regulations, and policies governing currency and capital controls. Includes a 5-page list of references and a short annotated bibliography.

52390 (PB–89-211783/XAB) **Opportunities to protect instream flows and wetland uses of water in California.** Majors, J.E.; Gould, G.A. Denver Univ., CO (USA). Coll. of Law. Mar 1989. 86p. Available from NTIS, PC A05/MF A01.

The publication is one of a series that provides a survey of State prerogatives and programs that may be used to protect the instream uses of water. Most of the opportunities for protecting instream flows are related to fish and wildlife habitat, although many other instream uses are considered, including hydroelectric power production, recreation, navigation, downstream delivery, and waste load assimilation. These documents illustrate methods to protect instream uses within the context of existing laws and regulations.

52391 (PB–89-215156/XAB) **Draft resource plan and environmental impact statement for the Nellis Air Force Range Planning Area, Caliente Resource Area, Nevada.** Bureau of Land Management, Las Vegas, NV (USA). Las Vegas District. 1989. 156p. (BLM/LV/PT–89/007/1610). Available from NTIS, PC A08/MF A01.

Also available from Supt. of Docs.

The Nellis Air Force Range Draft Resource Plan (DRP) and Draft Environmental Impact Statement (DEIS) explores future management options for the 2,209,326 acre planning area within Clark, Nye and Lincoln Counties in southern Nevada. The planning area is located in the Caliente Resource Area of the Bureau of Land Management's Las Vegas District, Las Vegas, Nevada. The need for the Resource Plan resulted from the passage of the Military Lands Withdrawal Act of 1986, as amended by Public Law (PL) 100-338, which withdrew the land for military purposes. The DRP/DEIS is prepared as a single planning document to address the intensity of BLM resource management on the Nellis Air Force Range. Two alternatives are considered in detail: Alternative A (No Action Alternative) represents a continuation of current management direction within the framework of present laws and regulations. Alternative B, the Preferred Alternative, would direct management attention toward improving rangeland vegetative conditions and wildlife habitat by achieving and maintaining the appropriate management level for the wild horse population on the planning area.

52392 (PB–89-217939/XAB) **Wilderness recommendations for Caliente Resource Area, Nevada. Environmental impact statement (Final).** Collins, B.F.; Spang, E.F. Bureau of Land Management, Las Vegas, NV (USA). Las Vegas District. 1988. 264p. (BLM/LV/PT–88/014/8500). Available from NTIS, PC A12/MF A01.

Also available from Supt. of Docs. Portions of this document are not fully legible.

The EIS analyzes the potential impacts of designating or not designating as wilderness, all or portions of five WSAs, comprising 588,423 acres, in southern Lincoln and northern Clark Counties, Nevada, and to identify reasonable alternatives. The scoping process for the Caliente Wilderness EIS developed issues identified by Bureau staff. The environmental issues identified for analysis in the EIS are impacts on: Wilderness values; Development of mineral resources; Motorized recreational use; Grazing facility maintenance and construction; ncreased production of deer and bighorn sheep as related to vegetation manipulation; Cultural resources; Water quality in the Clover mountains WSA; Development of utilities.

2905 Research, Development, Demonstration, and Commercialization

Refer also to citation(s) 52366, 52423, 52430, 52454

52393 (ORNL/TM–11139) **Inter-institutional decision making in the technology transfer process: Some preliminary issues in the evaluation of ORNL's High-Temperature Superconductivity Pilot Center.** Feldman, D.L. Oak Ridge National Lab., TN (USA). Sep 1989. 27p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90001242. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report illuminates the decision-making processes affecting technology transfer at ORNL as they potentially impact upon development of high-temperature superconductors. The methodology of this report consists of an analysis of Oak Ridge National Laboratory (ORNL) documents laws, and regulations; a review of relevant literature on licensing, patents, and user center decision making; and interviews with persons directly involved in technology development and transfer at the laboratory. The process of technology development at ORNL encompasses, among other things, activities aimed at research and development (R & D), technology transfer, and technology utilization. Each of these activities has officially become part of an overall laboratory mission referred to as technology development. 28 refs., 1 fig., 3 tabs.

52394 (UCRL–50007-88) **Annual Technology Review, 1988: Hazards Control Department.** Campbell, G.W.; Anderson, K.J. (eds.). Lawrence Livermore National Lab., CA (USA). Jun 1989. 108p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90000906. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The Annual Technology Review highlights some of the research conducted in the LLNL Hazards Control Department in Fiscal Year 1988 (October 1987–September 1988). Out intended audience for this report is the professional community and anyone with an interest in general health and safety related research; the articles give sufficient background for readers without any expertise in the subject. We hope the Annual conveys the diversity and scope of research conducted in the Hazards Control Department. The seven major sections in the Annual cover specific concerns in the areas of Chemical Protective Clothing, Air Filtration, Industrial Hygiene, Fire Science, Health Physics, Criticality Safety, and Instrument Development. For a broader overview of other work conducted in Fiscal Year 1988, we have compiled the abstracts of recent publications by Department members. Readers interested in more detail on any of the papers in the Annual may contact the authors directly c/o the Hazards Control Department, Lawrence Livermore National Laboratory. 70 refs., 61 figs., 21 tabs.

2906 Nuclear Energy

Refer also to citation(s) 51789, 51790, 51791, 51792, 51793, 52221, 52223, 52226, 52227, 52349, 52374, 52378, 52420, 52856

52395 (ORNL/TM–11288) **Comprehensive self-assessment and upgrade program progress report for the period January 1–June 30, 1989.** Lin, K.H.; Standifer, P.; Vaughen, V.C.A. Oak Ridge National Lab., TN (USA). Sep 1989. 59p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90001853. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The philosophy and practice in managing and conducting business in nuclear industry in general, and in DOE facilities in particular, have been changing rapidly in recent years. Strong emphasis has been placed on organization, training, compliance, and documentation in safety and quality of operations. This is reflected in the development of the Technical Safety Appraisal (TSA) procedures by DOE for formal evaluation of the DOE facilities. Awareness of the rapidly changing regulatory environment and the TSA activities led the Chemical Technology Division (Chem Tech) to initiate a Comprehensive Self Assessment and Upgrade Program (CSAUP) in January 1989, based on four key elements derived from the HFIR restart experience. These key elements include: perform serious self-evaluation using performance-based objectives and criteria, have independent reviews of operations, ensure that criteria exist for justifying continued operation, and have a process available for addressing problems as they arise and for tracking their resolutions. This report presents the progress made in addressing the key elements listed above during the period January-June, 1989. In essence, the actions to address the first key element included (1) preparation of general self-assessment plan, (2) development of Chem Tech-specific TSA performance objectives and criteria (POC) based on the DOE/TSA-POC, and (3) systematic self-evaluation of the Chem Tech radiochemical processing facilities and operating practices against these POC. Regarding the second key element, there have been evaluations of Chem Tech facilities and operations by four different pre-TSA inspection/auditing teams; all except one were from outside of ORNL. 1 fig., 9 tabs.

52396 **Statement of Ben C. Rusche, Director, Office of Civilian Radioactive Waste Management, Department of Energy.** pp. 583 of Nuclear waste program. Hearings before the Committee on Energy and Natural Resources, United States Senate, One Hundredth Congress, First Session, April 28 and 29, 1887, Part 2. Government Printing Office, Washington, DC (US) (1987).

The author appreciate the opportunity to appear before you today to discuss the Department of Energy's (DOE) proposal for Monitored Retrievable Storage (MRS). In our proposal, we recommend that Congress: Approve the construction of an MRS facility at Clinch River near Oak Ridge, Tennessee; Limit the storage capacity at the MRS facility to 15,000 metric tons of spent fuel; Preclude waste acceptance by the MRS facility until a construction authorization for the first repository is received from the NRC; Direct DOE to implement measures responsive to the concerns and recommendations of the State and local governments; and Direct DOE to implement the program plan accompanying the proposal. Before addressing several of the salient issues surrounding this proposal, I would like to provide relevant background information.

52397 **Statement of Roy F. Pruett, Mayor, City of Oak Ridge, TN.** pp. 583 of Nuclear waste program. Hearings before the Committee on Energy and Natural Resources, United States Senate, One Hundredth Congress, First Session, April 28 and 29, 1887, Part 2. Government Printing Office, Washington, DC (US) (1987).

Thank you very much, Mr. Chairman, and Members of the Committee. My name is Roy Pruett, mayor of the city of Oak Ridge, TN, and an executive committee member on the Clinch River MRS task force. It is my pleasure to be here today to testify before this distinguished Committee and present the findings of the Clinch River task force as they relate to subtitle C of the Nuclear Waste Policy Act of 1982, and to the Department of Energy proposal on the Monitored Retrievable Storage facility, the MRS. I represent the city of Oak Ridge, which has been selected for the primary and the first alternative for the siting of an integrated MRS facility for the preparation and packaging of high-level nuclear waste and spent reactor fuel. Of civic and governmental leaders, we concluded that an MRS could safely be built and operated in Oak Ridge. We further concluded, however, that the facility would not be generally perceived as being safe unless the recommendations of the task force were adopted to address concerns and help mitigate impact. Indeed the MRS would not be viewed as a net economic benefit to the site's community, the region, or the State of Tennessee without such appropriate conditions.

52398 **Statement of Kenneth E. Yager, County Executive, Roane County, TN.** pp. 583 of Nuclear waste program. Hearings before the Committee on Energy and Natural Resources, United States Senate, One Hundredth Congress, First Session, April 28 and 29, 1887, Part 2. Government Printing Office, Washington, DC (US) (1987).

I am Ken Yager, I am the county executive for Roane County, TN which is the preferred site for the proposed Monitored Retrieval Storage facility, or the MRS. and I am submitting into the record additional written testimony which was written largely by the Honorable Robert Peele, who is sitting here, who is a member of the Roane County Board of Commissioners, our local legislative body. The premise of my remarks is that the Department of Energy proposal for the MRS in our county in unacceptable unless the Congress and the Department of Energy are to be willing partners with the local communities. Our considerations have been limited to: one, can an MRS be operated safely, and if so under what conditions; and what would be the impacts of the facility and how might they be mitigated. Our recommendations on those two points lead me to my earlier comment about being partners with the Congress, because our recommendations can be summed up simply, Mr. Chairman, as local control. We are exceedingly concerned about the prospect of being trapped in a national squeeze play, caught between a recognized need for a way to deal with nuclear waste and intense political efforts to put that problem in somebody else's back yard. And if we are to be that back yard, we would ask that the Congress and the Department of Energy recognize our stake in this national effort. We must have an equal role in the process.

52399 **Keynote address: International nuclear cooperation.** Kennedy, R.T. *Transactions of the American Nuclear Society (USA),* 58: 9-11 (1989). (CONF-8810179–: International conference on nuclear fission: fifty years of progress in energy security, Washington, DC (USA), 30 Oct - 4 nov 1988).

These meetings provide an important opportunity for the nuclear community to assess the scope and direction of its wide-ranging activities. Nuclear technology has given us the tools to understand and shape our physical environment in ways which can solve ancient problems of health, food supply, energy, and many others which affect the quality of our lives. International cooperation is necessary to secure the peaceful benefits of nuclear technology. Meeting global energy needs must be high on any priority list of issues for the coming decade and the 21st century. The satisfaction of energy needs is today and will increasingly be a crucial factor in international stability. Hand in hand with the need to assure energy sufficiency is the need to assure the long-term protection of the environment. Three key elements that give a useful framework for approaching the future of nuclear cooperation are technological factors, economic issues, and political acceptability. Technological avenues to greater safety must be vigorously pursued. Economic alternatives must be identified and objectively weighed. Most important of all, the framework of public confidence must be strengthened.

52400 **Nuclear power-accomplishments and prospects.** *Transactions of the American Nuclear Society (USA),* 58: 15-27 (1989). (CONF-8810179–: International conference on nuclear fission: fifty years of progress in energy security, Washington, DC (USA), 30 Oct - 4 nov 1988).

Nuclear energy is probably unique in being an international endeavor. The US was correct in 1973 in embracing nuclear energy, and is correct even today in continuing to champion and push this technology. Several major events justify this view. They include: the world's growing dependence on oil and America's increasing dependence on the unstable Middle East; steady high growth in electricity demand; culminated in this summer's record peak demands across the country, and while it was a hot summer, most of that increased demand was industrial activity-economic activity-not due to heat and

renewed emphasis on the environment. The job of nuclear utilities and manufacturers is to work with continuity towards greater reliability, safety, and economy of our plants as they exist today. Nuclear power offers clear objective advantages if one is able to look beyond the illusions of the immediate situation. Taipower believes that nuclear power should be the major energy resource for Taiwan in the future. The first problem facing Taipower is the long lead time required for project approval. The second problem Taipower faces is the difficulty in obtaining a public consensus. Three main rational and irrational reasons are decisive for this future development of nuclear energy in Germany: energy structure, economics, and public acceptance. The use of nuclear energy is ethically not irresponsible, but it is ethically irresponsible not to use nuclear energy. A lot of modifications on the European plants have taken place to try to minimize the chance of having an accident and, in case it should happen, to limit the consequences. Another problem is waste deposits. As long as there is no answer to this question, the public will continue to debate on this issue.

52401 **Introductory remarks.** Muntzing, L.M. *Transactions of the American Nuclear Society (USA),* 58: 31 (1989). (CONF-8810179–: International conference on nuclear fission: fifty years of progress in energy security, Washington, DC (USA), 30 Oct - 4 nov 1988).

Speakers from six countries offer ideas on the political, economic, and public acceptance factors influencing nuclear power. Different views are presented, but safe operations are a common goal. Nuclear programs need international political support. There is a constant battle between safety regulations and cost. The public is concerned with waste disposal. The concept that the peaceful nuclear atom has and will continue to contribute to improvement of life on this planet.

52402 **Economic, political, and public acceptance factors influencing the future of nuclear power in the United States.** Gray, J.E. *Transactions of the American Nuclear Society (USA),* 58: 32-34 (1989). (CONF-8810179–: International conference on nuclear fission: fifty years of progress in energy security, Washington, DC (USA), 30 Oct - 4 nov 1988).

Views are presented on the economic, political, and public acceptance factors influencing the future of nuclear power in the United States. Electricity has been the preferred energy choice throughout the world. Nuclear energy must produce a competitive economic result along with energy supply security and environmental impacts. In the United States there exists ample experience and capacity to plan, design, construct, and operate new large nuclear power plants which could be competitive. Even at the lowest level of apparent safety and acceptance there was on the whole enough economic incentive and political support to keep the enterprise going. According to the United States Council for Energy Awareness polls, public acceptance is positive. The long-term outlook of nuclear power should be favorable. The one thing which would preclude nuclear power having a future in the United States would be for all parties to insist on eliminating all risks.

52403 **Nuclear power and public acceptance.** Hirschmann, H. *Transactions of the American Nuclear Society (USA),* 58: 35-38 (1989). (CONF-8810179–: International conference on nuclear fission: fifty years of progress in energy security, Washington, DC (USA), 30 Oct - 4 nov 1988).

Public acceptance is a decisive factor of growing importance, although economics has been and will remain the most decisive factor in ordering new nuclear capacity. Nuclear energy can make an important contribution toward preventing and reducing the greenhouse effect. Many politicians tend to base their decisions not on facts but rather on so called public opinion and consequently to overreact in particular on environmental issues. The entire debate hinges on public confidence rather than on a lack of information. There is no 100% guarantee that technical facilities will operate completely accident-free. Therefore, standards should be harmonized, plants should be operated safely and consequences of possible accidents should be limited. There needs to be some kind of early information system between countries concerning upcoming issues as a prerequisite for acting instead of reacting, because this is an essential tool in convincing the public that they can have more confidence. Technical information alone does not answer the real questions of the public. Political, technical, and economic matters as well as public opinion are interwoven and cannot be separated from each. Therefore, the exchange of experience gained in all these sectors on an international basis must be improved.

52404 **The future of nuclear power in Latin America.** Eibenschutz, J. *Transactions of the American Nuclear Society (USA),* 58: 39-41 (1989). (CONF-8810179–: International conference on nuclear fission: fifty years of progress in energy security, Washington, DC (USA), 30 Oct - 4 nov 1988).

The purpose of this paper is to analyze the future prospects of nuclear power in Latin America. As part of the developing world, Latin America has a great potential for energy growth. Although there are substantial differences among the different countries of the area, one common denominator is the relatively low per-capita energy consumption. As in many other regions of the world, nuclear power makes sense to complement hydro and fossil-fueled power generation. One of the main restrictions to the growth of nuclear power has been the relatively small size of some electric system. As in most developing countries, the damage to the environment due to the energy-producing systems is very important. In countries like Cuba, nuclear power is clearly the most economical source, since the country lacks indigenous energy resources and the need to import primary energy sources favors nuclear power. The problem of the Latin American region is a severe shortage of financial resources. Standardization has been recognized as one of the better mechanisms to lower nuclear power costs. Argentina has been proposing the construction of CANDU-type reactors as the basis for their standard program, and some years ago Mexico took steps to launch a program for the installation of ≈20 identical units. As in the whole world, the general public is reluctant to accept nuclear power. So far, nuclear power plants have been important to Latin America, with varying levels of local participation, but with imported technology. Unless a major scientific breakthrough takes place, nuclear power will constitute an important component of the energy system in Latin America.

52405 **The role and future of nuclear power in Canada.** Runnalls, O.J.C. *Transactions of the American Nuclear Society (USA),* 58: 42-48 (1989). (CONF-8810179–: International conference on nuclear fission: fifty years of progress in energy security, Washington, DC (USA), 30 Oct - 4 nov 1988).

Canada is rich in energy. Hydraulic power is the main source of electricity in Canada. The availability of natural resources and energy has guided the economic development of all the provinces. The Canadian Nuclear Association sponsored a survey of public attitudes in May of 1988. There appears to be less understanding of the actual supply of electricity and of the future natural resource availability. One out of five Canadians strongly opposes the use of nuclear energy. The CANDU type reactor proven to be a very economical and reliable choice in Canada. With the attention now being focused on the greenhouse effect and acid rain in Canada, opinion leaders, even in the traditionally antinuclear environmental community, are reconsidering the nuclear option. A significant hurdle has to be cleared in the relatively near future: a public review of the deep geologic high-level waste disposal concept. Groundwork has been laid to prepare for significant participation in a nuclear renaissance, across Canada and around the world.

52406 **Nuclear power in the Soviet Union.** Ponomarev-Stepnoi, N.N. *Transactions of the American Nuclear Society (USA),* 58: 52-56 (1989). (CONF-8810179–: International conference on nuclear fission: fifty years of progress in energy security, Washington, DC (USA), 30 Oct - 4 nov 1988).

The pros and cons of nuclear power are similar in many countries, but the following pro factors are specific to the Soviet Union: the major sources of conventional fuel are in one area of the country, but energy consumption is concentrated in another; and a large portion of energy is generated using oil and gas. The arguments against nuclear power are as follows: safety requirements and expectations have been increased; and public opinion is negative. A program of nuclear power generation has been developed. New techniques are being implemented to increase safety and enhance operations of different types of nuclear power plants. Its should be obvious in the future that a nuclear power plant has better economic and environmental parameters than existing methods of power generation.

52407 Proceedings of the international conference on nuclear fission: Fifty years of progress in energy security. *Transactions of the American Nuclear Society (USA),* 58: 3-109 (1989). (CONF-8810179–: International conference on nuclear fission: fifty years of progress in energy security, Washington, DC (USA), 30 Oct - 4 nov 1988).

Separate abstracts were prepared for the presentations in this publication. Topics include: international nuclear cooperation; political, economic, and public acceptance factors influencing the future of nuclear power; contributions of nuclear fission; and the international fuel cycle.

2907 Transport and Storage

52408 (LBL–26260, pp. 18.1-18.6) **Energy and transport in China.** Hongnian, Yang. Lawrence Berkeley Lab., CA (USA). Nov 1988. (CONF-8806261–: Chinese/American symposium on energy markets and the future of energy demand, Nanjing (China), 22-24 Jun 1988). In *Proceedings of the Chinese-American symposium on energy markets and the future of energy demands.* Order Number DE89012862. Available from NTIS, PC A12/MF A01.

This paper discusses the issues of energy transport and energy demand of transport in China. Development and utilization of energy are seriously limited by transport conditions. The transport sector consumes vast amounts of energy, and the shortage of petroleum fuels influences the development of transport. Problems of energy transport are freight volume, traffic flow and transport structure. Statistics on energy consumption in 1985 and forecasts for the year 2000 are given for railway, road, civil aviation, waterway and pipeline. Measures to solve the problems include; increased energy production, priority on oil fuel supply for transport, and reduced energy consumption.

2908 Waste Heat Utilization

Refer also to citation(s) 53279

2910 Conservation

Refer also to citation(s) 52115, 52408, 52437, 52452, 52455, 52456, 52457, 52463, 52465, 52466, 52469, 52470, 52493

52409 (DOE/CE–0245-3) **FEMP Update: Federal Energy Management Activities, Summer 1989.** USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Federal Energy Management Program. [1989]. 16p. Sponsored by U.S. DOE Conservation & Renewable Energy. Order Number DE90001870. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The FEMP Update, published quarterly by the Federal Energy Management Program (FEMP), provides information that will assist Federal managers in their energy management responsibilities. The Update is distributed primarily to Federal facility and energy management personnel.

52410 (DOE/MA–0383) **Annual report on in-house energy management, FY 1988.** USDOE Assistant Secretary for Management and Administration, Washington, DC (USA). Office of Project and Facilities Management. Oct 1989. 49p. Sponsored by U.S. DOE Management & Administration. Order Number DE90000908. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Each Federal Executive agency is required by the Code of Federal Regulations (CFR) to submit an "Annual Report on Energy Management. " During Fiscal Year 1988, the Department of Energy (DOE) completed its third year of operation under its Ten-Year Inhouse Energy Management Plan for FY 1986–FY 1995. This Annual Report will address program activities during FY 1988, summarize total program achievements, as well as evaluate progress toward the achievement of DOE efficiency and energy reduction goals as outlined in the ten-year plan. 39 figs., 5 tabs.

2920 Supply, Demand, and Forecasting

Refer also to citation(s) 51751, 52374

52411 (IEE-SR–201) **Actual record in term of year 1987 and short-term prospect of energy demand. Energy-demand Short-Term Trend Investigation Committee report.** 9901613. Institute of Energy Economics, Tokyo (Japan). 5 Oct 1988. 134p. (In Japanese). Order Number DE89760374. Available from NTIS (US Sales Only), PC A07/MF A01.

The energy demand, having been in a decreasing tendency in 1986, suddenly changed into a considerably increasing tendency in 1987, with an increasing ratio of 5.2%, which was the maximum after the first oil crisis. It was attributable to the economic recovery in the construction, transportation and other industries, as well as the large energy consuming industries such as steel, chemical and other industries. With the low price level for crude and other energies, unchanged in 1988, moreover influenced by the strongness in yen, the energy demand continued, in total though there were differences among the energy departments, to be in an increasing tendency, due to the economy being continuously activated. Both the supply and final consumption of energy in the term of year 1988 are expected to be almost equal in increasing ratio to those in the term of year 1987. Though it is still premature to conclude the taking a step in a new direction after having finished the adjustment in energy demand and supply after the oil crisis, a similar symptoms are found in Europe and America, too. For the stable security, the supply and combination of energy for future themes to be discussed. 31 figures, 82 tables.

52412 (PB–89-203061/XAB) **Perspective on energy activities in Africa. Final report.** DeLucia and Associates, Inc., Cambridge, MA (USA). Oct 1988. 35p. Available from NTIS, PC A03/MF A01.

The extent and complexity of Africa's energy problems require a variety of development-assistance interventions. The study proposes three types. The first would support the creation/development of private enterprises that would promote less-costly, more-efficient, and more-reliable end-use energy utilization. The second intervention, to supply electrical power to market towns, is already a focus of discussion and benefits of such an activity are analyzed, followed by outlines for a proposed feasibility study and pilot projects. The third intervention concerns improving the production and delivery of electricity and of modern (petroleum, coal, gas) and traditional fuels. Recommendations are presented for improving the fuel-marketing and power systems. Includes bibliography.

2930 Policy, Legislation, and Regulation

Refer also to citation(s) 52229, 52276, 52374, 52378, 52410, 52960, 53257, 53426

52413 (PNL-SA–17173) **Implementation of an EPA [Environmental Protection Agency] compliance-related QA [quality assurance] program within the NQA-1 criteria.** English, S.L. Pacific Northwest Lab., Richland, WA (USA). Oct 1989. 5p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-891042–3: 31. ORNL/DOE conference on analytical chemistry in energy technology, Gatlinburg, TN (USA), 10-12 Oct 1989). Order Number DE90001391. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Within the federal government there is a new era of increased mutual involvement and cooperation between the US Department of Energy (DOE) and the Environmental Protection Agency (EPA) for the protection of the health and safety of the general public and environment. With the increased interaction between DOE, EPA, and state agencies concerning hazardous waste, analytical laboratories must reevaluate their quality assurance (QA) programs. Pacific Northwest Laboratory (PNL) initially implemented a QA program using appropriate requirements from the voluntary consensus standard ANSI/ASME NQA-1. Increased interaction with the EPA has dictated the need to consider the QA requirements for analytical activities associated with the Resource Conservation and Recovery Act (RCRA), which are addressed in Chapter 1 of the EPA document, Test Methods for Evaluating Solid Waste (SW-846). PNL has determined that the RCRA QA requirements can easily fit within the NQA-1 structure. Both programs have benefits to offer the analytical laboratory.

2940 Fossil Fuels

Refer also to citation(s) 51681, 51691, 51696, 51704, 51705, 51707, 51727, 52374, 52420, 52464

52414 (DOE/EIA–0125(89/2Q)) **Coal distribution, January–June 1989.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 13 Oct 1989. 101p. Sponsored by U.S. DOE Management & Administration. Order Number DE90001487. Available from NTIS, PC A06/MF A01 - GPO - OSTI; GPO Dep.

The Coal Distribution report provides information on coal production, distribution, and stocks in the United States to a wide audience including Congress, Federal and State agencies, the coal industry, and the general public. The data in this report are collected and published by the Energy Information Administration (EIA) to fulfill its data collection and dissemination responsibilities as specified in the Federal Energy Administration Act of 1974 (Public Law 93-275, Sections 5 and 13, as amended). This issue presents information for January through June 1989. Coal distribution data are shown by coal- producing district of origin, consumer use, method of transportation, and State of destination. All data in this report were collected by the EIA on Form EIA-6, "Coal Distribution Report."

52415 (OCS/MMS–89-0055) **Outer Continental Shelf Oil and Gas Leasing/Production Program: Annual report/FY 1988.** Minerals Management Service, Herndon, VA (USA). 1988. 40p. Sponsored by U.S. Department of the Interior. Available from OSTI - Minerals Management Service, 381 Elden Street, Herndon, VA 22070-4817.

This annual report on the Outer Continental Shelf (OCS) Oil and Gas Leasing and Production program summarizes receipts and expenditures, and includes information on OCS safety violations as reported by the US Coast Guard. 3 figs., 12 tabs.

52416 (ORNL/TM–11259) **Oil vulnerability and intermediate price fluctuations: A preliminary assessment and proposal.** Curlee, T.R.; Reister, D.B. Oak Ridge National Lab., TN (USA). Sep 1989. 27p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90001855. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Most of the work of oil vulnerability has focused on the implications and appropriate public and private responses to short-term oil price spikes. This report focuses on the possibility that the world oil market is inherently more prone to large intermediate price fluctuations that are often triggered by short-term disturbances. The purposes of this report are to (1) pose the question of whether large and repeated intermediate price swings are a likely outcome, given our knowledge of the world oil market, (2) address how the effectiveness of policy instruments designed to mitigate the impacts of oil vulnerability may change in a world in which large intermediate oil price fluctuations are expected, and (3) propose future research that would address in greater detail the potential for, and appropriate responses to, large intermediate price swings on the world and domestic oil markets. The report concludes that there are plausible conceptualizations under which oil prices may fluctuate over the intermediate term. It is suggested that a major focus of future work should be on how the structure of the oil market may itself change over time, causing oil prices to go up and down. The report also concludes that the implications of such price swings may be significant for both the types and quantities of mitigation measures held by the public and private sectors. Finally, it is argued that the current world oil market provides a valuable opportunity for studying how oil prices may fluctuate over the intermediate term and how US energy policies can best be structured to cope with oil vulnerability. 48 refs., 2 figs.

2950 Hydrogen and Synthetic Fuels

Refer also to citation(s) 52464

2960 Electric Power

Refer also to citation(s) 52159

52417 (DOE/EIA–0226(89/07)) **Electric power monthly, July 1989.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 13 Oct 1989. 184p. Sponsored by U.S. DOE Management & Administration. Order Number DE90002123. Available from NTIS, PC A08/MF A01 - GPO - OSTI; GPO Dep.

The Electric Power Monthly (EPM) is prepared by the Electric Power Division; Office of Coal, Nuclear, Electric and Alternate Fuels; Energy Information Administration (EIA); Department of Energy. The purpose of this publication is to provide energy decisionmakers with accurate and timely information. The EPM presents monthly summaries of electric utility statistics at the national, Census division, and State level for net generation, fuel consumption, fuel stocks, quantity and quality of fuel, cost of fuel, electricity sales, and retail prices of electricity. Quantity, quality, and cost of fuel data lag the net generation, fuel consumption, fuel stocks, electricity sales, and retail prices data by 1 month. This difference in reporting appears in the national, Census division, and State level tables. However, at the plant level, all statistics presented are for the earlier month for the purpose of comparison.

52418 (PB–89-203087/XAB) **Options to increase private participation in electric power development in A.I.D. (Agency for International Development)-assisted countries.** Agency for International Development, Washington, DC (USA). Office of Energy. 23 Dec 1987. 123p. (REPT–88-15). Available from NTIS, PC A06/MF A01.

This report focuses on a Congressional request for an analysis of possible incentives to encourage the private sector of the U.S. and developing countries to contribute to providing reliable, affordable electrical power for economic and social development. The objectives of the report are to evaluate the need for private-sector involvement; to review existing programs and identify their shortcomings; and to propose financial and nonfinancial incentives options for promoting private-sector participation in the power sector of developing countries.

52419 (PB–89-204101/XAB) **Demand for energy in the Illinois coal market.** Ellis, M.F. Ellis (M. Fred), Pawnee, IL (USA). May 1989. 318p. Available from NTIS, PC A14/MF A01.

This report analyzes the 33 electric utilities with generating stations greater than 50 megawatts in capacity that purchased Illinois coal in 1986. Only electric utilities are analyzed since they consume nearly 90% of Illinois' annual coal production, or about 57 million tons. The remainder of sales are primarily to the industrial sector. The report contains information on each of the 13 states where these utilities are located and provides Illinois coal sales data since 1981. It lists the competing fuels that are used in these states. Data on nuclear fuel purchases and consumption are not available, but the study does include information on nuclear capability, both present and future. Utility data covering a general description of the company, generating statistics, and coal data are also included.

2980 Consumption and Utilization

Refer also to citation(s) 51720, 51721, 51722, 52408, 52417

52420 (DOE/EIA–0035(89/05)) **Monthly energy review, May 1989.** USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Markets and End Use. 24 Aug 1989. 141p. Sponsored by U.S. DOE Management & Administration. Order Number DE90002124. Available from NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.

The Monthly Energy Review presents current data on production, consumption, stocks, imports, exports, and prices of the principal energy commodities in the United States. Also included are data on international production of crude oil, consumption of petroleum products, petroleum stocks, and production of electricity from nuclear-powered facilities.

52421 (DOE/EIA–0376(87)) **State energy price and expenditure report 1987.** USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Markets and End Use. 22 Sep 1989. 249p. Sponsored by U.S. DOE Management & Administration. Order Number DE90000748. Available from NTIS, PC A12/MF A01 - OSTI; GPO Dep.

The State Energy Price and Expenditure Report (SEPER) presents energy price and expenditure estimates for the 50 States, the District of Columbia, and the United States. The estimates are provided by energy source and economic sector. Energy price and expenditure estimates are published for the years 1970, 1975, and 1980 through 1987. Data for all years, 1970 through 1987, are available on computer tape and diskettes. Consumption estimates used to calculate expenditures, and the documentation for those estimates, are from the State Energy Data Report, Consumption Estimates, 1960–1987 (SEDR), published in April 1989. Expenditures are calculated as the product of the consumption estimates, adjusted to remove process fuel and intermediate product consumption, and the price estimates. All expenditures are consumer expenditures, that is, they represent estimates of money directly spent by consumers to purchase energy, generally including taxes.

2990 Unconventional Sources and Power Generation

Refer also to citation(s) 52132

52422 (PB–89-204242/XAB) **Electric power from sugar cane in Costa Rica. A technical and economic analysis.** Tugwell, F.; Gowen, M.; Kenda, W.; Cohen, A. TEM Associates, Inc., Berkeley, CA (USA). Jul 1988. 150p. Available from NTIS, PC A07/MF A01.

Also pub. as Agency for International Development, Washington, DC. Office of Energy rept. no. REPT-88-18.

A team of specialists visited Costa Rica in May 1988 to analyze the potential for production and sale of electricity by the sugar-cane industry. Focusing on three sugar mills, the team made technical projections at four levels of investment, ranging from the simplest sale of surplus power to the installation of new turbogenerator systems. For each level, capital costs, electricity production and sales, and fuel options were estimated. Associated risks were assessed through sensitivity analyses to demonstrate the possible impacts of varying interest rates, fuel costs, and electricity sales prices. The team concluded that production and sale of electricity for the national grid could be an excellent investment opportunity for the sugar industry and would provide important economic benefits, including creation of additional jobs in rural areas, diversification of the sugar industry, and (in the short term) displacement of the need for imported fuels.

52423 (PB–89-208136/XAB) **Current alternative energy research and development in Illinois, December 1988. Annual report.** Swager, R. Illinois Dept. of Energy and Natural Resources, Springfield, IL (USA). Office of Solid Waste and Renewable Resources. May 1989. 125p. (IL/ENR/AE–86/01(88)). Available from NTIS, PC A06/MF A01.

See also PB–88-210471.

This Directory is intended to acquaint researchers, policy makers and citizens with recent activities in alternative energy research, development and demonstration projects. The topics covered were limited to those concerned with the development of non-fossil, nonnuclear energy sources. Included are projects in process in October 1988 or that have been completed after December 1987. It attempts to include projects performed by Illinois organizations, both within the state and out-of-state, and projects performed by out-of-state organizations at sites within Illinois.

30 DIRECT ENERGY CONVERSION

3001 MHD Generators

52424 (AD-A–209499/3/XAB) **Theoretical model of gravitational perturbation of current collector axisymmetric flow field. Research and development report.** Walker, J.S.; Brown, S.H.; Sondergaard, N.A. David Taylor Research Center, Bethesda, MD (USA). Mar 1989. 44p. (DTRC–89/004). Available from NTIS, PC A03/MF A01.

Some designs of liquid-metal collectors in homopolar motors and generators are essentially rotating liquid-metal fluids in cylindrical channels with free surfaces and will, at critical rotational speeds, become unstable. An investigation is being performed to understand the role of gravity in modifying this ejection instability. Some gravitational effects can be theoretically treated by perturbation techniques on the axisymmetric base flow of the liquid metal. This leads to a modification of previously calculated critical current collector ejection values neglecting gravity effects. The purpose of this report is to document the derivation of the mathematical model which determines the perturbation of the liquid-metal base flow due to gravitational effects. Since gravity is a small force compared with the centrifugal effects, the base-flow solutions can be expanded in inverse powers of the Froude number and modified liquid flow profiles can be determined as a function of the azimuthal angle. This model will be used in later work to theoretically study the effects of gravity on the ejection point of the current collector. A rederivation of the hydrodynamic instability threshold of a liquid metal current collector is presented.

3003 Thermoelectric Generators

Refer also to citation(s) 52028

52425 (HESS–8801, pp. 16-19) **Experimental studies of thermoelectric sodium conversion.** Masuda, Toshihisa (Electrotechnical Lab., Tsukuba (Japan)); Negishi, Akira; Tanaka, Kotaro; Honda, Takeo. Hydrogen Energy System Society, Tokyo (Japan). 17 Nov 1988. (In Japanese). (CONF-8811261–: 9. conference on researches on hydrogen energy system, Tokyo (Japan), 17 Nov 1988). In *Proceedings of the 9. conference on researches on hydrogen energy system*. Order Number DE89772179. Available from NTIS (US Sales Only), PC A04/MF A01.

This paper outlines an experiment of thermoelectric sodium conversion. The high-pressure side is fed with liquid sodium by an electromagnetic pump, which is heated to temperatures between 600 - 1,000°C and whose vapor pressure is increased to between $3.0*10^3$ and $2.6*10^5$Pa. β" alumina is a solid electrolyte capable of conducting electricity through sodium ions. Sodium ions, when passing through the β" alumina, are neutralized on the electrode face by electrons (which have already generated power for an external load), evaporated in a low-temperature (100 - 500°C) vacuum tank, and liquefied on the condensation face. Sodium vapor pressure ranges between 10^-4 and 10_3Pa. The vapor pressure difference between the above and the high-temperature side constitutes the driving force for sodium ions. When the sodium temperature was 800°C, the condensation face temperature was 270°C, and the internal resistance was 0.33 ohms-cm^2, the opening voltage of the Mo electrode was 0.98 V, the short-circuit current was 1.8 A/cm^2, and the output density was 0.34 W/cm^2, 65% of that of its theoretical value. A power generation experiment using a β" alumina tube showed a sodium temperature of 880°C, an opening voltage of 1.39 V, an operating voltage of 0.58 V, an operating current density of 0.81 A/cm^2, and an output density of 0.47 W/cm^2. 6 references, 4 figures.

52426 **Liquid Metal Thermal Electric Converter.** Moreno, J.B. (Sandia National Labs., Albuquerque, NM (US)); Abbin, J.P.; Andraka, C.E.; Lukens, L.L. vp of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y American Society of Mechanical Engineers, New York, NY (1988). (CONF-880702–: 23. intersociety energy conversion engineering conference, Denver, CO (USA), 31 Jul - 5 aug 1988).

Technical Paper 889111.

The Liquid Metal Thermal Electric Converter (LMTEC) is a thermodynamic heat engine with no moving parts that has the potential for high efficiency and low operating and maintenance costs in a number of terrestrial and space applications. At Sandia National Laboratories, the LMTEC has been studied theoretically and experimentally as a candidate for solar dish electric systems. The primary goals have been to improve and adapt the existing technology to solar requirements. As part of this effort, a 25-kWe solarized LMTEC conceptual design was produced and a bench test module (BTM) was constructed and tested. The BTM incorporated a number of new design innovations that were conceived especially for a solarized LMTEC. The maximum electrical power extracted from the BTM was a small fraction of the level expected. Using a detailed computer model for BTM performance, the major results were

shown to be consistent with high electrode flow resistance. The same conclusion was reached using a new experimental electrode evaluation technique.

3004 Thermionic Converters

Refer also to citation(s) 52210

52427 Preliminary investigations of a thermotunnel converter. Huffman, F.N. (Thermo Electron Corp., Waltham, MA (US)); Haq, Z. vp of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y American Society of Mechanical Engineers, New York, NY (1988). (CONF-880702–: 23. intersociety energy conversion engineering conference, Denver, CO (USA), 31 Jul - 5 aug 1988).

Technical Paper 889218.

The thermotunnel converter (TTC) is a novel means of converting heat into electricity; it uses no moving parts and has characteristics in common with both thermionic and thermoelectric converters. Electron transport occurs via quantum mechanical tunneling between electrodes at different temperatures. Cesium intercalated highly oriented pyrolytic graphite (HOPG) is used to form a multiplicity of TTCs in electrical and thermal series. An analytical model of the TTC has been formulated. This model, as well as extrapolation of low-temperature, lightly loaded potassium intercalated HOPG thermoelectric data to higher temperatures and heavy loadings, indicate that the TTC has the potential for higher efficiencies than conventional thermoelectric materials. Initial TTC test data show that thermal EMF values are comparable to theoretical calculations. However, the reductions in HOPG electrical resistivity and thermal conductivity are less than expected.

3005 Fuel Cells

Refer also to citation(s) 52365, 52366

52428 (DOE/METC–89/6105) **Proceedings of the first annual fuel cells contractors review meeting.** Huber, W.J. (ed.). USDOE Morgantown Energy Technology Center, WV (USA). May 1989. 386p. Sponsored by U.S. DOE Fossil Energy. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (USA), 2-4 May 1989). Order Number DE89011699. Available from NTIS, PC A17/MF A01 - OSTI; GPO Dep.

The overall objective of this program is to develop the essential technology for private sector commercialization of the various fuel cell electrical generation systems. The purpose of this meeting was to bring together the research and development (R&D) participants in the DOE/Fossil Energy-sponsored Fuel Cells Program to present key results of their research. Major emphasis was on phosphoric acid, molten carbonate, and solid oxide technology efforts. Research results of the coal gasification and gas stream cleanup R&D activities pertinent to the Fuel Cells Program were also highlighted. Thirty-six papers and poster presentations were given in six formal sessions and one informal poster session: Solid Oxide Fuel Cells R&D (10 papers); Solid Oxide Fuel Cells Systems Studies (1 paper); Molten Carbonate Fuel Cells R&D (9 papers); Molten Carbonate Fuel Cells System Studies (3 papers); METC's On-Site Gasification/Cleanup Program (1 paper); Phosphoric Acid Fuel Cells R&D (8 papers); and Poster Presentations (4 presentations by METC on R&D coal gasification and gas stream cleanup pertinent to the Fuel Cells Program). Individual projects are processed separately for the data bases.

52429 (EPRI-GS–6504) **Planar solid oxide fuel cell development: Final report.** Hsu, M. Electric Power Research Inst., Palo Alto, CA (USA); Ztek Corp., Waltham, MA (USA). c Oct 1989. 57p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This final report summarizes the result of the planar solid oxide fuel cell (SOFC) component assessment carried out under EPRI Research Project RP1676-09. The effort under this program focused on interconnector material stability, reactant flow distribution, and stack integrity in case of damage occurring to one of the plates. The SOFC is a high efficiency electrical generator, operating at 1000°C, and utilizing zirconia membranes as the electrolyte. The topics that were identified above are among the key issues which must be addressed before components can be scaled up and tested in multi-kilowatt stacks. Under the project, a 4-inch diameter fuel cell stack, consisting of ten cells, was tested for 1000 hours. Post-test results indicated that the selected interconnector material of 0.010 inch thickness has a projected life exceeding 40,000 hours. Gas flow distribution in the plane of the electrolyte and through the stack was empirically determined to validate an analytical model. The interconnector design was capable of distributing the reactants uniformly and the key parameters for scaling to full-size 10 kW modules have been identified. Two five-cell stacks were compared; one stack had a fractured electrolyte, the other had intact electrolytes. The test demonstrated that the interconnectors contributed to the integrity of the stack i.e., a single cell damage was contained locally, and without resulting in an open circuit to the stack. 17 figs., 5 tabs.

52430 (ETDE-IT–89-11) **Phosphoric acid fuel cell. R&D carried out in Italy: Planned activities.** Ascoli, A. Centro Informazioni Studi Esperienze, Milan (Italy). Apr 1987. 19p. (CONF-8510511–1: CEE workshop on potential, state of the art and R and D requirements for fuel cells in the European community, Noordwijkerhout (Netherlands), 7-8 Oct 1985). Order Number DE89793127. Available from NTIS (US Sales Only), PC A03.

Work on phosphoric acid fuel cells and stack research, development and demonstration is being performed in Italy in essentially three places: CISE SpA, Segrate (Milan), ANSALDO Componenti, Genoa and Institute CNR/ITAE, Messina. Promotional campaigns and nation wide coordination relative to these activities have been proposed in the 'Volta Project', a preliminary feasibility study prepared for ENEA (Italy) by a team of specialists of the above mentioned and other interested parties. The relevant state-of-the-art technology and proposed planning are briefly reviewed in this paper.

52431 (LA-UR–89-2947) **Heat and mass transfer design issues in PEM fuel cell hardware.** Nguyen, Trung; Hedstrom, J.C.; Vanderborgh, N.E. Los Alamos National Lab., NM (USA). [1989]. 12p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-7405-ENG-36. (CONF-891113–1: American Institute of Chemical Engineers annual meeting, San Francisco, CA (USA), 5-10 Nov 1989). Order Number DE89016779. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Dynamic moisture transport within polymeric electrolytes influences PEM fuel cell performance. Lowering electrolyte moisture content leads to decreased ionic transport rates, and other long term effects including polymer degradation. Results illustrate anode dehydration, the effect of water transport concurrent with the proton flux, is significant in single cells at current densities exceeding 500 ma/cm^2, and at higher temperatures. Evaporation and condensation to and from the gas phase contribute significantly to the cell thermal flows. Several strategies for successful high current density operation of these devices are presented. 9 refs., 7 figs.

52432 (NEDO–8809, pp. 296-316) **Overall technological development of phosphoric-acid fuel cell. Development of 200-kW-class electric-power-generating system for business use.** Tomei, Hideaki (Mitsubishi Electric Corp., Tokyo (Japan)). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the 8th NEDO General Assembly.* Available from NTIS (US Sales Only), PC A23/MF A01.

Study on the elemental technology and trial production and operation of a 200kW class power generating plant are being carried on as the project of Overall Technological Development of Phsphoric Acid Fuel Cell which has been commissioned by NEDO. Based on the result of the study made in 1986 to 1987, basic design of a 200kW class power generating plant was worked out for the trial production and operational study of the power generation plant. Elemental technologies were developed for cell, high performance cooling, reforming, invertor, system, etc. A 200kW class business use fuel cell power generating equipment was basically designed reflecting the result of the elemental technologies. It was structured to suit specifically for the business power generating system. The main system flow diagram and equipment layout drawing are

shown. It is expected that the development targets for efficiency, dimension, weight, environment, operational characteristics, etc. will be achieved. 13 figures, 8 tables.

52433 (NEDOJ–8809, pp. 317-335) **Research and development of molten carbonate fuel cell. Development of transformed large capacity stack.** Sano, Akira (Ishikawajima-Harima Heavy Industries, Co., Ltd., Tokyo (Japan)). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the 8th NEDO General Assemby.* Available from NTIS (US Sales Only), PC A23/MF A01.

The target of the project, Research and Development of Molten Carbonate Fuel Cell, which is a part of the Moonlight Project is the development of a 100kW class stack by 1991 and 1,000kW class pilot plant by 1995. The current status of the development of a tranformed large capacity stack for the achievement of the target is reported. Studies were made on the elongation of electrode's life, stabilization of electrolyte plate, operation technology under 3 atmospheric pressure, and the method of binding. For the production of material for large surface cell, studies were made on the improvement in the accuracy of the dimensions of electrode and electrolyte plate; and the improvement of the pore structure. Development of the technology of making internal manifold type separators by thin plate processing has started. In the study of a large scale cell, rectangular shaped anode with the electrode area of 1,800 x 570 mm and a holder for cathode were made by machining and investigated. The performance of this single cell gradually went down with the passage of time. 25 figures, 4 tables.

52434 (PB–89-218002/XAB) **Production and characterization of non-platinum catalytic materials formed by ion implantation. Annual report, November 1, 1987-October 31, 1988.** Greenwald, A.C.; Jalan, V. Spire Corp., Bedford, MA (USA). Apr 1989. 26p. (AR–20342-02). Available from NTIS, PC A03/MF A01.

See also PB–88-203161.

Catalytic activity for oxygen-ion production in a phosphoric acid fuel cell was observed with electrodes prepared with nitrogen ion-implanted carbon blacks. The electrodes were prepared without the addition of any metals. Comparisons to electrodes prepared with metal-ion implants is presented. Methods of preparation and electrochemical evaluation methods are discussed.

52435 (PB–89-218010/XAB) **Impact of fundamental technical improvements to natural gas fuel cells. 1988 annual report.** Maricle, D.L. International Fuel Cells Corp., South Windsor, CT (USA). Jun 1989. 36p. (FCR–9643A). Available from NTIS, PC A03/MF A01.

The objective of the program is to identify the fundamental limitations of phosphoric acid and solid oxide fuel cells and define research paths for solution of the high-priority limitations. Thirty opportunities for improving the phosphoric acid power plant were identified in a comparison of an 'ideal' power plant to the current capability of a 200-kilowatt, learned-out, commercial power plant. The highest-priority technical opportunities were assessed and the benefit payoff calculated. The top four areas are: performance improvement (80 mV), performance stability, an anode catalyst which could shift CO and not be poisoned by its presence, and methods to reduce cell stack material cost by 50%.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

3201 Buildings

Refer also to citation(s) 51862, 52115, 52362, 52410, 53546

52436 (DOE/ER/60698–1) **Worldwide studies of household radon exposure and lung cancer.** Neuberger, J.S. Kansas Univ., Kansas City, KS (USA). Dept. of Preventive Medicine. Jun 1989. 80p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-88ER60698. Order Number DE90001199. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The purpose of this paper is to summarize the ongoing studies of household radon exposure and lung cancer. To accomplish the above objective, a registry of ongoing epidemiologic studies was consulted. A questionnaire was sent to all known investigators. Principal investigators reviewed their listing and provided copies of their questionnaires. Ongoing studies are larger in size and provide more complete information on radon exposures and various confounders (e.g., cigarette smoking and occupation) than do most previously published studies. For example, out of 17 case/control studies in progress, almost all will collect information on active and passive smoking, occupation, and residential history. Ten of the studies will collect information on family history of cancer and diet. However, although the ongoing studies are more sophisticated, they generally are not standardized in protocol design or questionnaire development. Hence it may prove somewhat difficult to combine a number of studies. The feasibility of pooling data from these studies should be examined by experts in meta-analysis. If results from these studies are inconsistent or negative with respect to radon exposure and lung cancer, then a further study or studies should be considered. Such a study could be in a high radon area, use standardized protocols and questionnaires and be a multi-center, collaborative effort. A feasibility study for such an expanded epidemiologic effort is recommended. 44 refs., 9 tabs.

52437 (ETDE-IT–89-05) **ENEA's (Italy) energy conservation program for existing buildings: Energy audit and user information.** Del Bufalo, S.; D'Errico, E.; Funaro, G. ENEA, Casaccia (Italy). Dipt. Fonti Alternative e Risparmio Energetico. Sep 1986. 8p. Order Number DE89793122. Available from NTIS (US Sales Only), PC A02.

The paper focuses on ENEA's (Italian Commission for Nuclear and Alternative Energy Sources) efforts towards the reduction of heating expenses in existing buildings. The authors report on a joint project between ENEA and the Consortium of Institutes for Low Incoming Housing of Lombardia (CRIACPL). The aim of this project was to develop and experiment methods of energy diagnosis to select the most convenient investments to be made integrated with building maintenance. The paper also illustrates a simple guide, summarizing the results of the diagnosis. This guide was published in order to increase energy awareness and give practical suggestions with regard to energy saving options to home owners and housing institutions.

52438 (ETDE-mf–0711180) **The absorption system 'silica gel/water vapour'. Applications in solar air conditioning systems.** Khelifa, N. Muenchen Univ. (Germany, F.R.). Fakultaet fuer Physik. 3 May 1985. 209p. (In German). Order Number DE90711180. Available from NTIS (US Sales Only), PC A10/MF A01.

The main system offered nowadays for solar air-conditioning is the continuous LiBr absorption machine. It requires high propulsion temperatures to attain a good coefficient of cooling performance. The adsorption systems are simpler. These are not only capable of generating cold, but also of storing heat. The open systems are advantageous in this connection. The study shows that silica gel is particularly suitable as an adsorber for steam required for solar air-conditioning. It begins with an investigation of the general properties of the adsorbate-adsorbent pairs studied, after which it proceeds to examine adsorption theories and the results of experimental studies. It then describes the air-conditioning system of silica gel steam air, and considers the use of the molecular sieve 13X for air-conditioning. Finally, the methanol molecular sieve system 13X is introduced and its suitability for the generation of temperatures around 300^{0}C discussed. (BR).

52439 (FRNC-TH–3478) **Contribution to the theoretical and experimental study and to the modelling of a cascade mounted high temperature heat pump.** Yuan, Q.S. Institut National Polytechnique, 38 - Grenoble (France). 1987. 204p. (In French). Order Number DE90713659. Available from NTIS (US Sales Only), PC A10/MF A01.

After a review of the basic principles concerning heat exchangers, compressors and thermodynamic fluids, a design model has been used to optimize a combined heat-pump-vapour mechanical compression system, mounted in a cascade assembly. A two-stage heat pump operating with R114 and water was then constructed and tested. The performances are analyzed and compared with the model results.

52440 (IEIE–8802, pp. 4) **New illumination for office and related problems.** Takahashi, Sadao (Toshiba Corp., Kawasaki (Japan)). Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related to electricity and information.* Available from NTIS (US Sales Only), PC A02/MF A01.

The current state of new illumination for office and future problems are studied. The investigation conducted in 1980 on the actual conditions of illumination in Japanese buildings indicated that the average was 7291x which can be considered as the representative office illumination. Introduction of the so-called Office Automation started in around 1983, and lighting equipment which suits the VDT task has come to be desired. Intelligent Office moved into the spotlight as the second step for the New Office, and the illumination developed into many areas; (semi-) indirect illumination system, task-ambient illumination, etc. in addition to compact square shaped lighting equipment with fluorescent lamps and line lighting of direct illumination type. Glareless illumination, flexible illumination, and systematization of illumination are required for the illumination of new offices to meet the requirements for VDT task. 8 references, 4 tables.

52441 (IEIE–8802, pp. 4) **Status quo of office-illumination standards in Japan and abroad.** Kaneko, Naoaki (Toshiba Corp., Kawasaki (Japan)); Kohira, Sinji; Kakura, Tomoaki. Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related to electricity and information.* Available from NTIS (US Sales Only), PC A02/MF A01.

A part of the current state of standards for office illumination in Japan and abroad is introduced for the purpose of supporting planning, designing and evaluation of lighting environment. The outlines of laws, government ordinances, Ministerial ordinances, standards established by international agencies, international standards, and instructions and recommendations by organizations are introduced, and major standards for artificial illumination for the general office shown therein are presented. All of the atandards specify 500-7501x for general visual tasks and 750-10001x for exacting visual tasks and design or drawing works. Each country has a little different definition for the illumination. As the VDT work comes into common use, measures for health and safety are demanded, and each country has established various standards. The New Office Promotion Committee of MITI has prepared a manual called Guide to New Office. Guides in space, lighting, noise, safety, refreshment are given together with the related hardware and its control. 7 references, 4 tables.

52442 (IEIE–8802, pp. 4) **New viewpoint for lighting plan.** Saito, Mitsuo (Obayashi Corp., Osaka (Japan)). Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related to electricity and information.* Available from NTIS (US Sales Only), PC A02/MF A01.

Some of the new subjects to be considered for future office lighting plan are studied. The conditions required for office illumination are; provision of lighting (visual) environment which will improve the productivity, high reliability well-matched with the room design, low cost, high energy efficiency, flexibility to cope with the changes in lighting requisition, easy maintenance, etc. A desirable system for the future office illumination is the one which provides independent lighting control for each zone. Personalization of environment is necessary because there is a considerable individual difference in the levels of tolerance for the environment (light, heat, noise) and confortableness feeling among the office workers. Formation of good atmosphere should be emphasized in the application of daylight. There is also a possibility of making the lighting plan in close connection with the designing of the building. Some types of industry may have 24-hour operating offices, and the illumination plan to meet the requirements for such a case should be studied. 2 references, 2 figures, 2 tables.

52443 (IEIE–8802, pp. 4) **Evaluation of new office lighting.** Nakamura, Yoshiki (Tokyo Institute of Technology (Japan)). Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related to electricity and information.* Available from NTIS (US Sales Only), PC A02/MF A01.

The result of the Investigation on Comfortable Visual Environment in the Intelligent Office is introduced. Elements were worked out which represent the environment to be investigated in such forms as enabling easy comparison. 30 photographs of the actual office spaces and 30 phtographs of a reduced scale model in which illumination system only has been modified were prepared as the elements. All of the elements were presented to interviewees for evaluation and classification into 5 grades, and the reasons for the classification were extracted and recorded. Then, a 1/15 reduced scale model was used for the evaluation of the impression. The factors were analyzed basing on the evaluated values of the interviewees, and 3 factors for comfortableness variation were obtained. It became clear that the visual environment in the office is evaluated by 4 groups of items, i.e., function, psychological peace of mind, feeling of brightness, and change. The features of impression agrees well with the classification of lighting systems, and the evaluation of impression is greatly influenced by the luminance distribution. 2 references, 5 figures, 3 tables.

52444 (IEIE–8802, pp. 4) **Dwelling survey for office illumination environment.** Igarashi, Tadaharu (Kajima Corp., Tokyo (Japan)). Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related to electricity and information.* Available from NTIS (US Sales Only), PC A02/MF A01.

Actual case of the dwelling survey made for office illumination environment is introduced. As there is no standard for questionairing, original questionaire was prepared, and the survey was carried out using the same building for which actual measurement had been performed. Although the actually measured values satisfied the standard, there were considerable negative answers for some kinds of subjects in the questionaire. Except for illuminance, all the standards for the items to be evaluated are those established by academic societies and organizations in foreign countries, and are not official standards. As to methods for actual measurement, nothing has been standardized except for illuminance and brightness. It seems probable that standardization may become necessary for the items to be investigated, method of investigation, analytical method, etc.. For the investigation of interior lighting environment, review of the evaluation items, simple method for evaluation, evaluation method using questionaire, and development of the overall interior environment investigation method seem to become necessary. 5 references, 1 figure, 3 tables.

52445 (IEIE–8802, pp. 4) **Group control of elevators.** Umeda, Yasukazu (Mitsubishi Electric Corp., Tokyo (Japan)); Hikita, Shiro; Tuji, Sintaro. Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related to electricity and information.* Available from NTIS (US Sales Only), PC A02/MF A01.

Items to be evaluated in the group control of elevators, and a typical control system are described. A new system in which the fuzzy rule base is employed is introduced together with the configuration. The items to be evaluated are waiting time, riding time, accuracy of forecasting, energy saving, and ease of usage. The everage waiting time of less than 20 seconds with less than 3% waiting rate of more than 60 seconds is accepted as a satisfactory service condition. There are many conflicting matters in group-controlling, and the study for the controlling must deal with the optimization of multi-purpose problems. The standards for group-control evaluation differ

according to building structures and the tastes of users, and an important problem is where to give emphasis of the evaluation. The TRAFFIC PATTERN LEARNING METHOD has been applied in the system for careful control to accommodate the traffic. No specific function is provided for the evaluation, but the call allocation is made by fuzzy rule-base. The configuration of a new group-control system is introduced. 7 references, 7 figures, 1 table.

52446 (IEIE–8802, pp. 4) **Natural lighting and thermal insulation through window.** Matsuo, Akira (Univ. of Tokyo (Japan)); Inoue, Takashi. Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related to electricity and information.* Available from NTIS (US Sales Only), PC A02/MF A01.

Description is made on the computer simulation for quantitative investigation of the effect of artificial lighting control utilizing daylight, and problems in hardware and software for the improvement of comfortableness and energy saving by proper use of Venetial blinds are reported. A program called HASP-L was develped which is a modified version, with an added function for the calculation of daylight, of the previously developed dynamic thermal load computing program. Outlines of the building design data, outside conditions, daylight illuminance calculation, artificial light illuminance calculation, dimming methods and logic, and details of the output are presented. Examples of calculations performed in Tokyo and Sapporo areas are shown. In both cases, the power consumption was considerably reduced. As regards air conditioning, heating loads increased while cooling loads decreased. If both loads are combined, the loads decreased by 3-4% in Tokyo and incresed by 3-4% in Sapporo. The state of the use of the blinds was investigated to study the role and control effect of Venetian blinds. 7 references, 8 figures.

52447 (IEIE–8802, pp. 4) **Sunlight application system by reflection of light.** Kama, Hideki (Matsushita Electric Works, Ltd., Osaka (Japan)); Yamashita, Kimihei. Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related to electricity and information.* Available from NTIS (US Sales Only), PC A02/MF A01.

The sunlight application system by the reflection of light and the calculation for illuminance prediction are outlined. The objectives of sunlight introduction are divided into 3 categories, i.e., introduction of sunlight to the shade, courtyard/stairwell, or inside or basement of the building. 3 representative devices for the achievement of the objectives are introduced. The daylight changes hour by hour, largely varying its quality and amount. When the reflection of the direct sunlight is used, simulation for the illuminance prediction is performed by a large scale computer using the light path tracking method. Equipment, calculation formulas, flow chart of the predication simulation, and some examples of illuminance prediction are shown. In the prediction applying the skylight, the skylight only is taken into consideration, and the direct light is ignored since its incident directions and illuminace, in comparison with the skylight, change hour by hour. The predication calculation has 4 processes; establishment of the skylight illuminance, computation of the overall efficiency of the duct, calculation of outgoing beams and establishment of light distribution, and illuminance calculation. 3 references, 12 figures, 1 table.

52448 (INIS-GB–203) **Energy efficient factories: design and performance.** BRE Information Paper. no.13. Hughes, D. Building Research Establishment, Watford (UK); Department of Energy, London (UK). Jun 1989. 4p. Available from British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

BRE Information Paper.; no.13.

The monitoring of occupied factory premises built with fabric insulation to higher standards than required by building regulations, and insulated loading doors is described. (author).

52449 (NEDOJ–8809, pp. 336-350) **Development of superheat-pump energy-collection system. Development of extremely high-efficiency compression heat pump.** Hoyano, Tetsushi (Technology Research Association of Super Heat Pump Energy Accumulation). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the 8th NEDO General Assembly.* Available from NTIS (US Sales Only), PC A23/MF A01.

Commissioned by NEDO, investigation has been made for superheat pump energy collection system. The outline of the project, result of the study and development of extremely high efficiency compression heat pump up to 1987, and the relating future problems are reported. Design and trial production started in 1987, and the operational study is now being carried on. Features of 4 systems under development and the development situation are outlined. As an example of the result of development, developments of high efficiency heat pump serving for both hot and cold heat sources, and the one for high temperature output type low temperature heat source are introduced. A 100kW class thermal output bench plant was constructed and is now under test operation. A 1,000kW class thermal output pilot plant is planned to be designed and constructed after the performance of the bench plant is confirmed. The problem to be solved in the future is the regulation for the use of fleon. 11 figures, 5 tables.

52450 (ORNL–6527) **Guide for estimating differences in building heating and cooling energy due to changes in solar reflectance of a low-sloped roof.** Griggs, E.I.; Sharp, T.R.; MacDonald, J.M. Oak Ridge National Lab., TN (USA). Aug 1989. 57p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90000960. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This guidebook describes a procedure that can be used to estimate changes in heating and cooling costs and the net energy cost difference for a building as a result of changing roof "color", or more technically roof solar reflectance. The cost of heating and cooling a building is affected by roof color. A higher roof solar reflectance reduces the solar energy absorbed by the roof and therefore usually provides a reduction in the cost of air conditioning, while causing heating costs to increase. If the difference between reduced cooling costs and increased heating costs is significant, it can affect the choice of membrane for a new roof or a re-roofed building. This guidebook helps the user estimate this energy cost difference for his particular roof. It also describes how various factors influence potential energy savings and actual roof surface temperatures for different solar reflectances. The guidebook is intended to be used by building owners, roofing contractors, or other interested individuals who wish to evaluate the energy cost impacts of different roof solar reflectances. 31 refs., 15 figs.

52451 (ORNL/CON–253) **Laboratory study of the dynamic losses of a single speed, split system air-to-air heat pump having tube and plate fin heat exchangers, 1985–1986.** Miller, W.A. Oak Ridge National Lab., TN (USA). Aug 1989. 121p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90000970. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

An air-to-air split-system residential heat pump of nominal 9.7-kW (2 3/4-ton) capacity was instrumented and tested in the laboratory. The coefficient of performance capacity, and component efficiencies were measured during cooling and heating mode steady state and cycling conditions and under frosting and defrosting conditions. Improvement in cycling COP and capacity was observed by controlling off-cycle refrigerant migration. Best cycling COP and capacity performance occurred for cycling tests conducted with refrigerant isolated in the indoor heat exchanger during the off cycle, coupled with 2 min of extended indoor blower operation during the off-cycle. The frosting-defrosting experiments were conducted at outdoor ambient temperatures of 4.4, 1.7, and −3.8°C (40, 35, and 25°F) and for discrete humidity levels ranging from 60 through 80%. Frosting and defrosting algorithms were developed from the data for use in seasonal analysis simulations. Seasonal analysis calculations revealed that the reduction of frosting, defrosting, and cycling losses would result in a 3-year payback of roughly $150 to $300 to the consumer for most climatic regions in the United States. 19 refs., 75 figs., 24 tabs.

52452 (ORNL/CON–282) **Implementation of blower door and new client selection concepts into the Iowa Weatherization Assistance Program: Experimental plan.** Ternes, M.P.; Hwang, H.L.

Oak Ridge National Lab., TN (USA). Aug 1989. 98p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90001851. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The Iowa Pilot Project will be performed to test new methods (1) for prioritizing clients for the Weatherization Assistance Program, which are based upon consideration of potential savings and client needs by using energy consumption rather than other stated priorities, and (2) for performing infiltration reduction work that would use a blower door to help determine the level of work to perform (when to stop) and to locate major leakage areas that need to be sealed. This report presents an experimental plan with the goals and questions to be addressed by the pilot project, responsibilities of the six project participants, 11 tasks required to complete the pilot, detailed descriptions of the priority and infiltration reduction methods to be studied, experimental design, data requirements, and analysis procedures to be employed in the study of the collected data. 10 refs., 13 figs., 6 tabs.

52453 (ORNL/CON–291) **A protocol for monitoring energy efficency improvements in commercial and related buildings.** MacDonald, J.M.; Sharp, T.R.; Gettings, M.B. Oak Ridge National Lab., TN (USA). Sep 1989. 54p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90000968. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This document describes a protocol that addresses the basic measurement and reporting requirements for studies of costs and savings from energy efficiency improvements in commercial and related buildings. Significant advances have been made in methods for organizing and documenting metering studies in commercial and related buildings in this decade, and this protocol builds on these advances. Use of the protocol is intended to promote more consistency in how commercial buildings are described and how results are reported from such studies, which is intended to lead to increased understanding of field performance monitoring results. This protocol has been developed to support efforts of the Existing Buildings Efficiency Research (EBER) program of the Department of Energy. The strategy used for this protocol is to specify data requirements for describing the measured field performance of efficiency improvements in buildings. The requirements cover description of the projects, description of the analysis and reporting of specific analysis results, minimum requirements for measured data, and description of the monitored building(s) by use of a building description data set. We recommend that the EBER program begin using this protocol for studies of energy efficiency improvements in commercial and related buildings. 14 refs.

52454 (ORNL/M–932) **Building Thermal Envelope Systems and Materials (BTESM) and research utilization/technology transfer progress report for DOE Office of Buildings and Community Systems: Monthly progress report.** Coleman, G.; Samples, S.D. (comps.). Oak Ridge National Lab., TN (USA). Sep 1989. 79p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90000972. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The Monthly Report of the Building Thermal Envelope Systems and Materials (BTESM) Program is a monthly update of both in-house ORNL projects and subcontract activities in the research areas of building materials, wall systems, foundations, roofs, building diagnostics, and research utilization and technology transfer. Presentations are not stand-alone paragraphs every month. Their principal values are the short-time lapse between accomplishment and reporting and their evolution over a period of several months.

52455 (ORNL/Sub–88-SB964/1) **US building materials industry: R and D barriers assessment.** Klareich, F.H.; Franke, J.C. Oak Ridge National Lab., TN (USA); RCG/Hagler, Bailly, Inc., Washington, DC (USA). Sep 1989. 105p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90001844. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

US building material manufacturers are the primary source of building construction research and development (R&D) in the US. Compared with other mature industries, construction-related R&D spending is low. This low level of spending shows that significant barriers to private sector building materials R&D exist. Through an extensive literature search and discussions with industry, 27 barriers to private sector building materials R&D were identified. These barriers were then assessed against two criteria: their susceptibility to the influence of the Department of Energy (DOE) and Oak Ridge National Laboratory (ORNL) and their criticality to industry. The result was the development of a barrier assessment matrix, which prioritized the barriers by placing them into one of four relatively ranked sets: primary, secondary, exploratory, or marginal barriers. Those barriers that could not be influenced by DOE/ORNL were eliminated from further assessment by this process; those that could be influenced were prioritized to give DOE/ORNL a relative sense of their importance to industry and to the building energy conservation goals of DOE/ORNL. The results of this assessment show that DOE/ORNL should give immediate consideration to three primary barriers: lack of adequate measurement methods, lower perceived priority of energy conservation, and high cost of substantiating product performance. This assessment has also shown that DOE/ORNL, through the sponsorship of research activities, has a critical role to play in the reduction of building material R&D barriers and in stimulating private sector efforts in building construction research. 34 refs., 8 figs., 15 tabs.

52456 (PB–89-198287/XAB) **Quality-assurance procedures: Method 28 certification and auditing of wood heaters.** Ward, T.E.; Rives, G.D.; Hartman, M.W.; Olin, R.C. Radian Corp., Research Triangle Park, NC (USA). Jun 1989. 169p. Available from NTIS, PC A08/MF A01.

Quality-assurance procedures are contained in this comprehensive document intended to be used as an aid for wood-heater manufacturers and testing laboratories in performing particulate-matter sampling of wood heaters according to EPA protocol, Method 28. These procedures may be used in research and development, and as an aid in auditing and certification testing. A detailed, step-by-step quality assurance guide is provided to aid in the procurement and assembly of testing apparatus, to clearly describe the procedures, and to facilitate data collection and reporting. Suggested data sheets are supplied that can be used as an aid for both recordkeeping and certification applications. Throughout the document, activity matrices are provided to serve as a summary reference. Checklists are also supplied that can be used by testing personnel. Finally, for the purposes of ensuring data quality, procedures are outlined for apparatus operation, maintenance, and auditing. These procedures combined with the detailed description of the sampling and analysis protocol will help ensure the accuracy and reliability of Method 28 emission testing results.

52457 (PB–89-198303/XAB) **Quality-assurance procedures: Method 5G determination of particulate emissions from wood heaters from a dilution tunnel sampling location.** Ward, T.E.; Hartman, M.W.; Olin, R.C.; Rives, G.D. Radian Corp., Research Triangle Park, NC (USA). Jun 1989. 200p. Available from NTIS, PC A09/MF A01.

Quality-assurance procedures are contained in this comprehensive document intended to be used as an aid for wood-heater manufacturers and testing laboratories in performing particulate matter sampling of wood heaters according to EPA protocol, Method 5G. These procedures may be used in research and development, and as an aid in auditing and certification testing. A detailed, step-by-step quality assurance guide is provided to aid in the procurement and assembly of testing apparatus, to clearly describe the procedures, and to facilitate data collection and reporting. Suggested data sheets are supplied that can be used as an aid for both recordkeeping and certification applications. Throughout the document, activity matrices are provided to serve as a summary reference. Checklists are also supplied that can be used by testing personnel. Finally, for the purposes of ensuring data quality, procedures are outlined for apparatus operation, maintenance, and traceability. These procedures combined with the detailed description of the sampling and analysis protocol will help ensure the accuracy and reliability of Method 5G emission-testing results.

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Refer also to citation(s) 52277, 52375, 52376, 52377, 52410, 53566, 53567

52458 (IEIE–8802, pp. 4) **Introduction. Transportation control and simulation for operating control.** Sekiya, Hisashi (Research Center for Advanced Science and Technology Univ. of Tokyo, Tokyo, Japan). Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related to electricity and information.* Available from NTIS (US Sales Only), PC A02/MF A01.

Basic viewpoints for the study of simulation technology for traffic and transportation as well as the result of the study are outlined. The current state of the characteristics and control of transportation, and the analytical method for operating control are introduced, laying stress on the application of simulation technology. The objectives of the simulation application technology for traffic and transportation are; evaluation, designing, system evaluation or operation training by simulators, simulation for operation, control of moving groups, centralized control, measurement of traffic network status, estimation of state, and the estimation of demand. The subjects to be handled by actually available simulation computing are; data of moving groups, dynamic characteristics, characteristics concerning traffic route, characteristics of traffic volume, and demands for traffic, whose outlines are described. In the fields other than the conventional traffic and transportation, there are many such similar fields as elevators, conveyers for cargo, etc. where simulation has been used. 3 figs.

52459 (IEIE–8802, pp. 4) **Air control.** Tofukuji, Noriyasu (Erectronic Navigation Research Inst. Tokyo, Japan). Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related to electricity and information.* Available from NTIS (US Sales Only), PC A02/MF A01.

The outline of the air control system is introduced to show its relationship with the aerial navigation, and lastly the future of the navigation control system is described. Reports are made on the air traffic and navigation control operation, control system for aerial navigation control, and the controlled interval. Aerial navigation control operation is divided into the terminal control operation and aerial route control operation. Natures of air traffic and the air control operation system in every air area are different. In connection with the air control and aerial navigation, reports are made on the departure approval, take-off climb, transfer of control to aerial route control, cruising flight in aerial route, starting of descent, transfer to terminal control, and approach and landing. Explanation on the approach of aircraft and maintenance of the controlled interval is also made. As regards the future air control system, reports on the artificial satellites and air-ground data link are made. 7 refs., 3 figs., 1 tab.

52460 (IEIE–8802, pp. 4) **Control of railroads and operating control.** Nozue, Naoji. Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related to electricity and information.* Available from NTIS (US Sales Only), PC A02/MF A01.

Flexible railroad transportation which will satisfy the need of the customers can be materialized by the employment of advanced information technology for the railroad operation system utilizing new information processing technology. The outline of the operating control system which is the core of the advanced information technology for the control and operation system of the railroad is described. Historical development of railroad control and operating control is outlined. In regard to collision prevention, description is made on signals, introduction of car-borne back-up device and control device, and route control. Centralized Traffic Control (CTC) utilizing electronic computers was developed for the detection of operational situation of trains, automatic planning for schedule changes to solve disturbance, and automatic output of the result for the route control. The 8 major functions of the train operating control system are ; tracking for trains, route control, communication with trains, monitoring for dealy, operating control, issuance of instructions, passenger guidance, monitoring of equipment, and control. 8 references, 8 figures, 2 tables.

52461 (IEIE–8802, pp. 4) **Automobile control technology and traffic control.** Takaba, Sadao (Univ. of Tokyo (Japan)). Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Joint convention record of institues of electrical and information engineers, Japan.* Available from NTIS (US Sales Only), PC A02/MF A01.

In the field of automobile control technology, electronic was first adopted for the electronic fuel control as an answer to the exhaust gas regulations. The operations of the driving system, frame system or the automobile itself which is the combination of the two were optimized by adding sensors, computers, actuators, etc. to alleviate the burden of the driver, offering easier drivability and confortableness. For local driving control, measurement of distance up to obstacle has been practiced using the ultrasonic radar sensor. Research and development of microwave radar sensor have been carried out for years. Automatic driving has been a dream technology, and the study for the technology was started since early times. Remarkable progress was made recently in the navigation system for traffic control in wide area. New automobile traffic information communication and other systems are being developed. Historical description is made on the control and information systems for road transportation, dividing the period into the 1st, 2nd and 3rd generations. 10 references.

52462 (IEIE–8802, pp. 4) **Automatic navigation technology and marine traffic control.** Fuwa, Takeshi (Ship Research Inst., Tokyo (Japan)); Koyama, Takeo. Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related to electricity and information.* Available from NTIS (US Sales Only), PC A02/MF A01.

The feature of the operation control for the ship is the extremely poor controlling force in comparison with its big inertial force. The automation history of the ship started with the development of wireless transmitter and navigation equipment, and proceeded with the progress of electronic technology. Automation and high reliability of the facilities now contribute to the elimination and reduction of labor. Although remarkable advancement has been made in the navigation equipment, automation of the operation for navigation has made little progress. The operation of the ship, different from that of the train and airplane, have many things in common with the operation of the automobile in which most of the operation and judgement depend on human ability. The importance of the marine traffic control is well recognized, and many kinds of measures have been taken for the improvement in safe navigation in congested sea areas, but in local places only. Conventional systems are introduced laying stress on the investigated cases concerning the DEVELOPMENT PROJECT OF HIGHLY RELIABLE INTELLIGENT SHIP and the IDIAL TRAFFIC CONTROL SYSTEM FOR THE 21ST CENTURY. 24 refs., 12 figs., 1 tab.

52463 (PB–89-198394/XAB) **Light rail transit: New system successes at affordable prices. Special report.** National Research Council, Washington, DC (USA). Transportation Research Board. 1989. 682p. (TRB/SR–221). Available from NTIS, PC A99/MF E04.

See also PB–86-166154. Library of Congress catalog card No. 89-31396.

The papers presented at the conference, along with several others submitted to and reviewed by TRB, are published in these proceedings. The report is organized into five headings: overview, policy and planning considerations, new LRT systems and lessons learned from start-ups, systems design and vehicle performance, and operations and maintenance. The consensus of the conference participants was, as conference program committee chairman R. David Minister put it, 'light-rail transit is alive and well in North

America.' The participants found that interest in LRT is at an all-time high and has not yet peaked, that many lessons have been learned from the successes and problems of existing systems, and that diversity of applications characterizes this mode.

52464 (PB–89-198626/XAB) **Fuels. Transportation Research Record.** Santini, D.J.; Koyama, K.; Darling, L.; Kurani, K.S.; Sperling, D. National Research Council, Washington, DC (USA). Transportation Research Board. 1988. 61p. (TRB/TRR–1175). Available from NTIS, PC A04/MF A01.

Library of Congress catalog card No. 89-3280.

The 5 papers in the report deal with the following areas: past and future of the petroleum problem: the increasing need to develop alternative transportation fuels; methanol supply and demand issues from a California perspective; rise and fall of diesel cars: a consumer-choice analysis; transportation fuels and the greenhouse effect; unleaded gasoline in the United States: a successful model of system innovation.

52465 (PB–89-198634/XAB) **Rail replacement and maintenance management. Transportation research record.** Staplin, D.E.; Wells, T.R.; Steele, R.K.; Joerms, M.W.; Orringer, O. National Research Council, Washington, DC (USA). Transportation Research Board. 1988. 92p. (TRB/TRR–1174). Available from NTIS, PC A05/MF A01.

Library of Congress catalog card No. 89-3431.

The 9 papers in the report deal with the following areas: branch-line rail replacement strategies; fatigue analysis of the effects of wheel load on rail life; rail testing: strategies for safe and economical rail quality assurance; production processes to yield superior rail steel; manufacture and properties of deep head hardened rail; in-situ rail-head rectification on British railways; technical and financial appraisal of a contemporary repair technique for rails and crossings; examination of methods to achieve rail lubrication; report from FAST–recent test experiences.

52466 (PB–89-198642/XAB) **Urban freeway operations. Transportation Research Record.** Dudek, C.L.; McCasland, W.R.; Burns, E.N.; Newman, L.; Nuworsoo, C. National Research Council, Washington, DC (USA). Transportation Research Board. 1988. 54p. (TRB/TRR–1173). Available from NTIS, PC A04/MF A01.

Library of Congress catalog card No. 89-3110.

The 7 papers in the report deal with the following areas: Promotional issues related to accident investigation sites in urban-freeway corridors; Location, design, and operation of accident-investigation sites in urban-freeway corridors; Operational and safety experience with freeway HOV facilities in California; Interstate 394 and the HELP-394 information number; Performance measurement for a metered freeway system; Effect of grade on the relationship between flow and occupancy on freeways; Impacts of TSM improvements on Eastbound St 520.

52467 (PB–89-207575/XAB) **Private-sector contracting for transit services: Operator handbook, March 1989.** ATE Management and Service Co., Inc., Cincinnati, OH (USA). Mar 1989. 219p. Available from NTIS, PC A10/MF A01.

See also PB–88-237367.

This handbook addresses the procedural difficulties in the development of contractual relationships between private operators and public agencies. The handbook focuses primarily on transit programs funded by UMTA. It is designed for private operators, not public agencies, and consists of practical how-to-do-it information about contracting. The market opportunities available through urban and rural transportation operators, cities and counties, human services agencies, schools, airports, and other sources are discussed. An overview of various funding sources, program trends and policies, and regulations of these programs that affect private sector participation is provided. The mechanics of the contracting process and how an operator can increase effectiveness in pursuing business contracts in transit is also addressed.

52468 (PB–89-207971/XAB) **ORION II bus demonstration. Demonstration report (Final).** Shanley, J. Central New York Regional Transportation Authority, Syracuse, NY (USA). Feb 1989. 123p. Available from NTIS, PC A06/MF A01.

The Central New York Regional Transportation Authority conducted an 18-month demonstration to determine how the ORION II bus operates in actual service. The ORION II vehicle is a small low floor, accessible heavy duty, diesel-powered transit bus designed to meet the needs of the elderly and handicapped. It has the capacity to seat 26 passengers with 4 wheelchair lockdowns. Side and rear doors are equipped with electrically powered ramps. Eight Thomas vehicles (22-foot, 11,500 lbs, wheelchair equipped, gasoline fueled) were also tested during the demonstration period. Operations (fuel and oil usage) and maintenance (scheduled and unscheduled) data were collected and charted-out in the report as well as driver, passenger, and maintenance surveys. This report provides descriptions, photographs, and comparison charts of both the diesel-fueled ORION II transit bus and the gasoline-fueled Thomas vehicles along with the demonstration test plan, evaluations, conclusions, and survey results.

52469 (PB–89-207997/XAB) **Safety, loss control, and risk management: An assessment of practices at 17 US bus transit agencies. Final report.** Abacus Technology Corp., Chevy Chase, MD (USA). Apr 1989. 191p. Available from NTIS, PC A09/MF A01.

This study was undertaken to identify the extent of losses from risks that transit agencies are experiencing and their current efforts to reduce losses. The study examined safety, loss control, and risk-management programs and practices at 17 bus-transit agencies, located in 14 states with fleet sizes ranging from 200-1000 vehicles. The study objectives were to: assess risk and liability exposure of bus-transit agencies; profile existing safety, loss control, and risk-management practices and programs; and recommend strategies to reduce losses. Data were collected through telephone and onsite interviews with contractor-managed transit agencies, regional transit agencies, and county/municipal transit agencies. The report presents background information on the project, observations and recommendations for further loss reductions. It lists the 17 participating bus-transit agencies, and presents a summary of noteworthy loss-control activities at each agency.

52470 (PB–89-209373/XAB) **Expenditure on bus transport by low-income households. Working paper.** Bradshaw, J. Oxford Univ. (UK). Transport Studies Unit. Mar 1988. 51p. (TSU/WP–416). Available from NTIS, PC EE04/MF E04.

Also pub. as York Univ. (England). Social Policy Research Unit rept. no. SPRU/WP-367.

Previous studies of the budgets of low-income households have shown that they can afford to spend relatively little on transport. However, low-income households are much more dependent for their transport on public transport, particularly buses. A study was commissioned to analyze household expenditure on buses. There were four aims of the analysis: to explore the characteristics of bus users; to establish the amount households spend on bus transport and how this varies with income and other factors; to estimate the proportion of household spending devoted to bus transport and how this varies with income and other factors; to investigate whether it is possible to discriminate between the characteristics of households who have a high or low expenditure on buses and to discern if possible whether high bus expenditure has an impact on other items of household expenditure.

52471 (SAND–89-0397) **Sandia Satellite Program summary of operational procedures.** Sandia National Labs., Albuquerque, NM (USA). Aug 1989. 59p. Sponsored by U.S. DOE Management & Administration. DOE Contract AC04-76DP00789. Order Number DE90000892. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Operational procedures for the Space Systems Department and Space Sensors Department are described. Departmental policies and procedures from design of systems for space applications through qualification for spaceflight are summarized. 1 fig.

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Refer also to citation(s) 52045, 52449, 52504, 53185, 53194, 53279, 53601

52472 (DOE/ER/13668–T1) **Integrated theoretical and experimental study of the thermophysical properties of fluid**

mixtures: Summary report, 1987–1988. Haynes, W.M. National Inst. of Standards and Technology, Boulder, CO (USA). Thermophysics Div. Aug 1988. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract AI01-87ER13668. Order Number DE90001197. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objective is to assist the chemical process and fuel industries to improve efficiency and thereby reduce the use of energy and feedstocks and to aid them in the utilization of unconventional feedstocks and energy sources. This objective can be satisfied by carrying out the following specific efforts: (1) development of predictive procedures for the properties of fluids and fluid mixtures; (2) basic understanding of fluid behavior with advances in theory; and (3) acquisition of experimental data to support theoretical modeling efforts. Emphasis is placed on increasing basic understanding of fluid behavior which will lead to the development of predictive models in the form of computer codes which can be readily transported to engineering users and are easily incorporated into industrial design and control packages. The results of all of the work, including the validation of predictive packages such as TRAPP and SUPERTRAPP, are published in refereed journals.

52473 (DOE/ER/13668–T2) **Integrated theoretical and experimental study of the thermophysical properties of fluid mixtures: Annual report.** Haynes, W.M. National Inst. of Standards and Technology, Boulder, CO (USA). Thermophysics Div. Sep 1987. 21p. Sponsored by U.S. DOE Energy Research. DOE Contract AI01-87ER13668. Order Number DE90001505. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objective is to assist the chemical process and fuel industries to improve efficiency and thereby reduce the use of energy and feedstocks and to aid them in the utilization of unconventional feedstocks and energy sources. This objective can be satisfied by carrying out the following specific efforts: (1) development of predictive procedures for the properties of fluids and fluid mixtures; (2) basic understanding of fluid behavior with advances in theory; and (3) acquisition of experimental data to support theoretical and modeling efforts. Emphasis is placed on increasing basic understanding of fluid behavior which will lead to the development of predictive models in the form of computer codes which can be readily transported to engineering users and are easily incorporated into industrial design and control packages. The results of all of the work, including the validation of predictive packages such as TRAPP and SUPERTRAPP, are published in refereed journals. 17 refs., 1 fig.

52474 (DOE/ID/12296–5) **High temperature burner-duct-recuperator system evaluation: Final report, October 1981–August 1988.** Parks, W.P. Jr.; DeBellis, C.L. Babcock and Wilcox Co., Lynchburg, VA (USA). Lynchburg Research Center. Aug 1989. 111p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FC07-81ID12296. Order Number DE89016730. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The Babcock & Wilcox Company (B&W) has completed a program to design, construct, install, and field test a ceramic-based high-temperature burner-duct-recuperator (HTBDR) in an industrial setting. The unit was capable of operating in corrosive, high temperature (2250°F) flue gas streams. The HTBDR was successfully tested in a steel soaking pit at B&W's Tubular Products Division in Koppel, PA. During the 1400 hour operation prior to plant closing, the ceramic stage performed well with no material related problems or air-to-flue leakage. The maximum preheat air produced was 1425°F with a flue gas temperature of 2170°F. Measured fuel savings of 17–24% were obtained over the previous recuperated (metallic heat exchanger) system. This projects to savings of 41% for an unrecuperated furnace. A simple payback analysis indicated acceptable payback for installation in unrecuperated furnaces but unacceptable payback for recuperated furnaces at today's low gas prices. In both cases return on investment is high over a ten year projected life expectancy. 14 refs., 67 figs., 16 tabs.

52475 (DOE/ID/12621–2) **Electroacoustic dewatering of food and other suspensions: Phase 2.** Kim, B.C.; Zelinski, M.S.; Criner, C.L.; Senapati, N.; Muralidhara, H.S.; Jirjis, B.; Beard, R.E.; Cummings, C.; Chauhan, S.P. Battelle Columbus Div., OH (USA). 31 May 1989. 239p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC07-85ID12621. Order Number DE90000742. Available from NTIS, PC A11/MF A01 - OSTI; GPO Dep.

The food processing industry is a large user of energy for evaporative drying due to limited effectiveness of conventional mechanical dewatering machines. Battelle's Electroacoustic Dewatering (EAD) process improves the performance of mechanical dewatering machines by superimposing electric and ultrasonic fields. A two phase development program to demonstrate the benefits of EAD was carried out in cooperation with the food processing industry, the National Food Processors Association (NFPA) and two equipment vendors. In Phase I, laboratory scale studies were carried out on a variety of food suspensions. The process was scaled up to small commercial scale in Phase II. The technical feasibility of EAD for a variety of food materials, without adversely affecting the food properties, was successfully demonstrated during this phase, which is the subject of this report. Two Process Research Units (PRUs) were designed and built through joint efforts between Battelle and two equipment vendors. A 0.5-meter wide belt press was tested on apple mash, corn fiber, and corn gluten at sites provided by two food processors. A high speed citrus juice finisher (a hybrid form of screw press and centrifuge) was tested on orange pulp. These tests were carried out jointly by Battelle, equipment vendors, NFPA, and food processors. The apple and citrus juice products were analyzed by food processors and NFPA. 26 figs., 30 tabs.

52476 (DOE/ID/12626–4) **Ordered ceramic membranes: Annual progress report, May 1988–May 1989.** Anderson, M.A.; Hill, C.G. Jr. Wisconsin Univ., Madison, WI (USA). Jun 1989. 37p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AS07-86ID12626. Order Number DE89017426. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

As in the first two years of this project, research during the third year covered three major areas: preparation and characterization of supports for the membranes; preparation and characterization of the membranes themselves; and determination of the behavior of systems in which the membranes are attached to supports. The primary interest in supports was to develop formulations which would provide more reproducible permeabilities (flux of water through the support). Several different clay formulations have been shown to give quite reproducible permeabilities, with the actual permeability varying by nearly an order of magnitude among the different formulations. Supports with smoother surfaces were also fabricated, but rejection studies which compared membranes coated on these supports to membranes coated on rougher supports did not show any significant differences. Ceramic membranes have been prepared which are composed of three different materials: alumina, titania and silica.

52477 (DOE/ID/12701–1) **Test and evaluation of polymeric membranes for oxygen enrichment of air: Final report.** Ragland, K.W.; Whipple, J.G. Wisconsin Univ., Madison, WI (USA). Jul 1989. 83p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC07-88ID12701. Order Number DE90000555. Available from NTIS, PC A05/MF A01 - OSTI.

Two A/G Technology hollow fiber polymeric membrane separation modules to produce oxygen enriched air were evaluated. In one module the inlet air was pressurized, and in the other a vacuum was pumped on the permeate side of the membrane. The pressurized module contained three cartridges each 3 in. o.d. by 54 in. long, while the vacuum module contained seven cartridges each 3 in. o.d. by 48 in. long. Laboratory performance tests of the modules were conducted, and an economic analysis of the membrane systems for industrial applications was done. The measured performance data were used along with vendor supplied compressor, vacuum pump and turbo-compressor data to analyses industrial air enrichment systems producting 1 ton equivalent pure O_2/day and 10 ton equivalent pure O_2/day enriched air at 35% oxygen. Both the pressurized and vacuum systems are economically attractive and provide a simple payback of less the two years when compared to the use of liquid oxygen. The vacuum system provides greater energy savings, while the pressurized system requires less capital investment. New A/G membranes are undergoing further development. 14 refs., 22 figs., 5 tabs.

52478 (EEO-ED–68/196) **High density cleaning of waste paper feedstock for paper board manufacture. A demonstration project at Thames Board Ltd., Purfleet.** Department of Energy, London (UK). Energy Efficiency Office; BORA Services Ltd., Bristol (UK). Sep 1985. 106p. Order Number DE90709234. Available from NTIS (US Sales Only), PC A06.

Energy Efficiency Demonstration Scheme report for the Energy Technology Support Unit (ETSU), Harwell (GB).

Thames Board Ltd produce at their Purfleet Mill a range of multiply paper boards for packaging purposes. The raw materials used are predominantly recycled waste papers. The conventional treatment of recycled waste papers, which today are heavily contaminated, is both complex and energy intensive. Simplification of the process should result in reduced energy consumption and lower capital, operating and maintenance costs. The Purfleet Mill stock preparation plant has been modified, so that a portion of the recycled waste is now treated in a seven stage process in which the fibres are cleaned at a consistency of 4 parts fibre in 96 parts water; instead of the former conventional 19 stage process in which the cleaning consistency is 1 part fibre in 99 parts water. This change has also permitted a decrease in the quantity of waste receiving pitch dispersal treatment by steam heating. (author).

52479 (EEO-ED–83/180) **Once-firing of ceramic tiles. A demonstration at Adderley Green Tiles Ltd. [Bucknall].** Department of Energy, London (UK). Energy Efficiency Office; British Ceramic Research Association, Stoke-on-Trent (UK). Jun 1986. 40p. Order Number DE90709241. Available from NTIS (US Sales Only), PC A03/MF A01.

Energy Efficiency Demonstration Scheme report for the Energy Technology Support Unit (ETSU), Harwell (GB).

A single-layer low thermal-mass roller-hearth kiln was incorporated into an automatic production system for the development and manufacture of a range of ceramic tiles. The total cost of the tile making and firing systems was Pound 1,246,000 excluding additional building work and a body preparation plant. When these additional items were included, the total project cost was approximately Pound 3,250,000. For the manufacture of floor tiles (once-fired), energy savings of 52%, compared with traditional methods, were achieved and overall manufacturing costs were reduced by 14%. The specific energy consumption for firing 200 x 200 x 8 mm tiles was found to be 2.79 MJ/kg (compared with an average of 5.80 MJ/kg for traditional tunnel kilns operating at the same factor) and the kiln thermal efficiency was 74%. (author).

52480 (EEO-ED–133/211) **Application of combustion control, ceramic fibre lining and waste heat recovery to lead refining kettles. [Demonstration at] Britannia Refined Metals Ltd. [Gravesend].** Department of Energy, London (UK). Energy Efficiency Office; BNF Metals Technology Centre, Wantage (UK). Sep 1987. 32p. Order Number DE90709244. Available from NTIS (US Sales Only), PC A03/MF A01.

Energy Efficiency Demonstration Scheme report for the Energy Technology Support Unit (ETSU), Harwell (GB).

Britannia Refined Metals Ltd (BRM) modified three of their lead refining kettles and, as a result, are now saving Pound 67,000/year. An energy audit carried out in 1976 indicated that the energy used to refine each tonne of metal was approximately 15 times greater than the energy consumption required to melt each tonne. BRM therefore decided that the refinery would be updated to make it more competitive and that one of the aims would be to improve the energy utilisation in the process. As a result, it was decided to improve the thermal efficiency of three process kettles by: recovering waste heat from the furnace gases and using it to pre-heat the burner combustion air; modifying the refractor design; replacing the existing burners with dual-fuel high-velocity burners; optimising the combustion conditions by improved pressure control; installing additional ceramic fibre thermal insulation; and installing larger capacity pots. (author).

52481 (EEO-ED–134/226) **Use of regenerative burners in a slot forge furnace. A demonstration at Dudley Drop Forgings Ltd.** Department of Energy, London (UK). Energy Efficiency Office; NIFES Consulting Engineers Ltd., Altrincham (UK). Jul 1987. 26p. Order Number DE90709242. Available from NTIS (US Sales Only), PC A03/MF A01.

Energy Efficiency Demonstration Scheme report for the Energy Technology Support Unit (ETSU), Harwell (GB).

The objectives of the project were to assess the performance of a prototype regenerative slot furnace and compare it with a conventional slot forge furnace working in a drop forge environment. In this the project proved successful and a 64.7% reduction in energy consumption was achieved by the regenerative furnace. The overall heat to metal efficiency has been raised to 23.7% compared with 3.7% for the conventional furnace monitored. The regenerative burner system is not suitable for a retro-fit onto existing elliptical slot furnaces, thus a total furnace replacement is necessary. The hearth is constructed of conventional dense refractory material and the roof and walls are a steel casing lined with low thermal mass ceramic fibre. (author).

52482 (EEO-ED–141/214) **Energy savings in a large pumped water supply scheme. A demonstration at Strensham Water Treatment Works Pumping Station, Severn-Trent Water Authority.** Department of Energy, London (UK). Energy Efficiency Office; Humphreys (Howard) and Partners, Leatherhead (UK). Sep 1987. 29p. Order Number DE90709243. Available from NTIS (US Sales Only), PC A03/MF A01.

Energy Efficiency Demonstration Scheme report for the Energy Technology Support Unit (ETSU), Harwell (GB).

The Strensham Water Treatment Works of Severn-Trent Water Authority (S-TWA) currently supplies approximately 80 M1/d to the Coventry area. After treatment water is pumped to a reservoir 57 km from Strensham. A programme of measures to improve pumping station performance was put in hand by S-TWA. These included modification and refurbishment of one of the pumps and the implementation of computer aided pump selection for pump operation. A study has shown that significant savings can be achieved by pump modification ensuring that an appropriate range of pumps is available to meet all operational requirements. More significantly the study has highlighted the need for good instrumentation and regular monitoring of pump performance to enable the operators to use the equipment in an efficient manner. In this context the benefits to be achieved by computer aided pump selection to meet varying demand can be demonstrated. During the course of the project the overall strategy has been reviewed and as a consequence surge vessels are being installed to allow an intermediate reservoir to be abandoned. It is predicted that this will lead to a reduction in the discharge head needed and an energy cost saving of the order of Pound 18,500/year, based on an average flow in the past of 30 M1/d through the reservoir. (author).

52483 (EEO-ED–166/191) **Application of regenerative burners to a continuous heat treatment furnace. Demonstration at BSC, Shepcote Lane Works [Sheffield].** Department of Energy, London (UK). Energy Efficiency Office; British Steel Corp., Rotherham (UK). Swinden Labs. Aug 1988. 52p. Order Number DE90709238. Available from NTIS (US Sales Only), PC A04/MF A01.

Energy Efficiency Demonstration Scheme report for the Energy Technology Support Unit (ETSU), Harwell (GB).

The application of regenerative burners to a continous heat treatment furnace at BSC Stainless, Shepcote Lane Works, has proved to be highly successful with savings of Pound 200 000/annum being achieved. The payback period on the energy saving component of the furnace was 1.7 years. BSC Stainless have found no major problems with regenerative burner technology and following the success of the project, have converted other furnaces to regenerative firing. (author).

52484 (EEO-ED–184/186) **Rapid heating of aluminium billets by porous element burners. A demonstration at Aluminium Corporation Ltd. Dolgarrog.** Department of Energy, London (UK). Energy Efficiency Office; British Steel Corp., Rotherham (UK). Swinden Labs. Sep 1987. 53p. Order Number DE90709245. Available from NTIS (US Sales Only), PC A04/MF A01.

Energy Efficiency Demonstration Scheme report for the Energy Technology Support Unit (ETSU), Harwell (GB).

The reheating of aluminium is usually carried out at temperatures between 550 and 600^{0}C. At these temperatures the heat transfer rate by radiation to a low emissivity surface is relatively low. A novel

rapid heating furnace using porous medium burners has been constructed. This furnace uses temperatures of 1300°C and direct flame impingement on the stock to give high rates of heat transfer. The furnace is controlled by measurement of stock temperature as opposed to furnace temperature. Because of the difficulties associated with the measurement of stock temperature on low emissivity surfaces a novel thermocouple contact method has been devised. The furnace was constructed in low thermal mass material. This construction, coupled with the reduced size of furnace necessary, gives a very low energy penalty to and through the structure. A major advantage of this type of furnace is its ability to respond rapidly to changing stock throughput conditions. From cold, the furnace can reheat aluminium to rolling temperature in only 30 min. This allows great flexibility for production. The savings obtained, compared with those predicted by a feasibility study, are low. This is mainly due to the furnace having a disappointing combustion efficiency of only 37.3%. Factors contributing to this have been identified. (author).

52485 (EEO-ED–193/187) **Waste heat recovery for use in distillation as identified by a process integration study. A demonstration at ICI plc. [Runcorn].** Mercer, A.C. Department of Energy, London (UK). Energy Efficiency Office. Mar 1988. 57p. Order Number DE90709239. Available from NTIS (US Sales Only), PC A04/MF A01.

Energy Efficiency Demonstration Scheme report for the Energy Technology Support Unit (ETSU), Harwell (GB).

ICI plc has carried out a process integration study on a chlorinated organics plant at Runcorn. The aims of the study are to: determine the minimum practical amount of energy required to operate a process; determine beneficial changes to the process itself and the site energy supply systems; and to identify the minimum-cost schemes that maximise savings in conformity with planning and operating criteria. The British-led development of pinch technology provides a more systematic approach. The techniques involves the rigorous application of thermodynamic principles and cost accounting while taking practical engineering and operability constraints into consideration. (author).

52486 (EEO-ED–202/185) **High level control of a kiln. A demonstration at Blue Circle Industries plc. Hope Works.** Department of Energy, London (UK). Energy Efficiency Office; Atkins (W.S.) and Partners, Epsom (UK). Jan 1988. 33p. Order Number DE90709240. Available from NTIS (US Sales Only), PC A03/MF A01.

Energy Efficiency Demonstration Scheme report for the Energy Technology Support Unit (ETSU), Harwell (GB).

Computer control offered a way of running the cement kiln consistently and at lower kiln temperatures, with consequent reduction in energy and other operating costs. Consequently a high level control system was installed in March 1985 on the No 2 kiln at the Blue Circle Hope Works. A second system was installed on the No 1 kiln in October 1985. Savings potentially worth around Pound 930,000/year have been achieved at the Blue Circle Hope Works by the application of this type of high level control system to an 80 tonne/hour dry process cement kiln. The associated payback period is around three months. (author).

52487 (N–89-24635) **Tribology: The Story of Lubrication and Wear.** Buckley, D.H.; Jones, W.R. Jr.; Sliney, H.E.; Zaretsky, E.V.; Townsend, D.P.; Loewenthal, S.H. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1985. 145p. (NASA-TM–101430;E–4535;NAS–1.15:101430;CONF-8510514–: Conference on tribology: the story of lubrication and wear, Cleveland, OH (USA), 18 Oct 1985). Available from NTIS, PC A07/MF A01.

Topics addressed include: lubrication and design of high speed rolling element bearings, high speed gears, and traction drives.

52488 (N–89-24635, pp. 55-81) **Solid lubricant materials for high temperatures: A review.** Sliney, H. E. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1985. (NASA-TM–101430;E–4535;NAS–1.15:101430;CONF-8510514–: Conference on tribology: the story of lubrication and wear, Cleveland, OH (USA), 18 Oct 1985). In *Tribology: The Story of Lubrication and Wear.* Available from NTIS, PC A07/MF A01.

Solid lubricants that can be used above 300 C in air are discussed, including coatings and self-lubricating composite bearing materials. The lubricants considered are representative dichalcogenides, graphite, graphite fluoride, polyimides, soft oxides, oxidatively stable fluorides, and hard coating materials. A few general design considerations revelant to solid lubrication are interspersed.

52489 (PB–89-192025/XAB) **Technology evaluation report: SITE (Superfund Innovative Technology Evaluation) program demonstration test. Terra Vac In-Situ Vacuum Extraction System, Groveland, Massachusetts. Volume 1.** Michaels, P.A. Foster Wheeler Enviresponse, Inc., Livingston, NJ (USA). Apr 1989. 112p. Available from NTIS, PC A06/MF A01.

See also Volume 2, PB–89-192033.

An evaluation was made of Terra Vac Inc.'s vacuum extraction system during a 56-day demonstration test run at Valley Manufactured Product Company's site in Groveland, Massachusetts. This site is part of the Groveland Wells Superfund site and is contaminated mainly by trichloroethylene. The report, one of three volumes, includes a detailed discussion of the operations of the vacuum extraction unit, a process description and diagram of the system and a summary of the sampling and analytical protocols. The final sampling and analytical report and the quality assurance project plan are included. An overall evaluation of the process cost and its applicability to other Superfund sites across the country is included. Both shallow-soil gas and soil VOC concentrations showed a decline with time which was correlatable. The process worked well in soils of both high and low permeability. The system operation was very reliable during the 56-day demonstration test run and the only operation attention required was to replace the spent activated-carbon canisters with fresh canisters.

52490 (PB–89-192033/XAB) **Technology evaluation report: SITE (Superfund Innovative Technology Evaluation) program demonstration test. Terra Vac In-Situ Vacuum Extraction System, Groveland, Massachusetts. Volume 2.** Michaels, P.A. Foster Wheeler Enviresponse, Inc., Livingston, NJ (USA). Apr 1989. 337p. Available from NTIS, PC A15/MF A01.

See also Volume 1, PB–89-192025. Portions of this document are not fully legible.

Sampling and analysis was conducted during the Terra-Vac In-situ Vacuum Extraction Project in Groveland, Massachusetts. The Terra-Vac process was demonstrated and tested under the U.S. Environmental Protection Agency's (EPA's) Superfund Innovative Technology Evaluation (SITE) program. The major objectives of the demonstration were: (1) determine the ability of the technology to reach an acceptable low level of contaminant concentration in the soil; (2) assess the effectiveness in various soil types; (3) gather capital and operating costs; and (4) gain performance and reliability information. A secondary objective was to establish a correlation between volatile organic concentrations in soils and concentration in extracted vapor. The report has been organized into three volumes. Volume II, Field Data Sheets, contains copies of the original daily sample data sheets which were used to record process conditions and sampling information. In addition, copies of the chain-of-custody sheets used during the project are also included.

52491 (PB–89-196075/XAB) **Statistical theory for sampling of time-varying industrial atmosphere contaminant levels. Final report.** Systems Control, Inc., Palo Alto, CA (USA). Jun 1974. 106p. (SCI–5103-1). Available from NTIS, PC A06/MF A01.

Decision and estimation procedures developed according to a statistical theory for the sampling of time-varying industrial atmosphere-contaminant levels are presented. Using these procedures, the 8-hour-time-average of an airborne contaminant can be determined.

52492 (PB–89-197016/XAB) **Investigation of emissions from a chipboard production plant.** Mitchell, D.; Scott, D.W. Warren Spring Lab., Stevenage (UK). 1988. 27p. (LR–639(PA)M). Available from NTIS, PC EE05/MF E05.

An investigation was carried out on the modified Babcock wood chip drier at the manufacturing plant of Kronospan Ltd at Chirk. Recommendations are made for 52m high at minimum freestanding stack for both the uprated Babcock drier and the refurbished No. 3

drier. The calculations were based on aldehyde emissions derived from previous investigations and these levels were confirmed for the Babcock drier during the present investigation. The study of stack emissions on the Babcock drier shows that the particulate and aldehyde emissions are within the planning agreement set out by Kronospan Ltd and Glyndwr District Council. The ambient levels of aldehydes found outside the works are a cause for concern and the study together with the investigation of the chipboard press lines indicate that there may be other sources of pollution apart from the main stack. Further investigations to identify and quantify other sources.

52493 (PB–89-206049/XAB) **Technical Digest No. 14. Energy management.** Louw, C.E. Centre for Scientific and Technical Information, Pretoria (South Africa). 1987. 123p. Available from NTIS, PC EE07/MF E07.

North American Continent sales only.

For a company to launch a successful energy-management program the following should be kept in mind: the management of the company must be enthusiastic about the program, see clear objectives and be willing to spend money on the program and later on capital improvements. Responsibility for the program must be placed in the hands of a qualified person. He must motivate employees in this regard and see to it that results are achieved and reported and controls are installed. An energy audit must be done that would result in changes with varying degrees of cost involved. Results must be documented and employees and management must be kept informed of progress.

52494 (PB–89-207831/XAB) **Material characterization of hot-mix recycled bituminous pavements. Final report.** Wood, L.E.; Noureldin, A.S. Purdue Univ., Lafayette, IN (USA). Joint Highway Research Project. 4 May 1988. 159p. (JHRP–87-11-F). Available from NTIS, PC A08/MF A01.

See also Executive Summary, PB–89-207849.

A detailed laboratory investigation was performed to characterize the performance of the hot-mix recycled asphalt pavement in comparison with a virgin mix. A virgin mixture and three recycled mixtures were evaluated. Marshall-size specimens were fabricated and evaluated using the pulse velocity, resilient modulus, indirect tensile strength, Hveem stability, and Marshall stability tests. In addition, the recycled binder itself was evaluated using a stage extraction technique and the thin-film oven test results. Long-term aging of recycled mixtures was also studied. Subjective conclusions were established for the performance of recycled mixtures under various conditions. Virgin mixture stiffness and strength parameters were higher than those of recycled mixtures. However, long-term aging properties of two of the recycled mixtures were better than the virgin mix, especially when regarding the failure tensile strain. The thin-film oven test and the indirect tensile test were identified as additional criteria for the choice of type and amount of recycling agent to be used.

52495 (PB–89-207849/XAB) **Material characterization of hot-mix recycled bituminous pavements. Executive Summary.** Wood, L.E.; Noureldin, A.S. Purdue Univ., Lafayette, IN (USA). Joint Highway Research Project. 4 May 1988. 12p. (JHRP–87-11-ES). Available from NTIS, PC A03/MF A01.

See also PB–89-207831.

A detailed laboratory investigation was performed to characterize the performance of the hot-mix recycled asphalt pavement in comparison with a virgin mix. A virgin mixture and three recycled mixtures were evaluated. Marshall-size specimens were fabricated and evaluated using the pulse velocity, resilient modulus, indirect tensile strength, Hveem stability, and Marshall stability tests. In addition, the recycled binder itself was evaluated using a stage extraction technique and the thin-film oven test results. Long-term aging of recycled mixtures was also studied. Subjective conclusions were established for the performance of recycled mixtures under various conditions. Virgin mixture stiffness and strength parameters were higher than those of recycled mixtures. However, long-term aging properties of two of the recycled mixtures were better than the virgin mix, especially when regarding the failure tensile strain. The thin-film oven test and the indirect tensile test were identified as additional criteria for the choice of type and amount of recycling agent to be used.

52496 (PB–89-208128/XAB) **Recycling planning and evaluation program documentation. Final report.** Lindsey, G.; Light, G.; Lechner, L. Illinois Association of Recycling Centers, Naperville, IL (USA). May 1989. 96p. Available from NTIS, PC A05/MF A01.

The Recycling Planning and Evaluation Program (REPEP) is a simple, menu-driven spreadsheet program that was developed to provide planners, engineers, and local and state officials with an easy to use tool for planning and evaluating source-separation programs. Planners can use the program to assess the feasibility of curbside, dropoff, buyback, yard waste, and commercial or industrial collection programs. REPEP is interactive; users can input data, run the program, and view or print results. Output from REPEP consists of a number of tabular reports for various types of recycling programs, including estimates of collection rates, diversion rates, and costs and revenues. REPEP was written for use on the SMART Software System. Ownership or access to the SMART Software System, or at least the SMART Spreadsheet, is required to operate the program. The report focuses on the structure of REPEP. It includes guidance for use of REPEP as a computerized planning tool. Little substantive information about source separation is included.

52497 (PB–89-210199/XAB) **Industrial exposure and control technologies for OSHA (Occupational Safety and Health Administration) regulated hazardous substances. Volume 1. Substances A-I. Volume 2. Substances K-Z and indices.** Occupational Safety and Health Administration, Washington, DC (USA). Mar 1989. 2334p. (OSHA/RP–89/003). Available from NTIS, PC A99/MF E16.

The information presented in the two-volume publication includes health, toxicity, economic, and technological data and other information on about 600 substances currently regulated, or candidates for regulation, by the Occupational Safety and Health Administration (OSHA). The information, also available on computer tape, is intended to serve as a reference for those who are potentially exposed to one or more of these substances in their workplace, for those who have supervisory or management responsibility for workers potentially exposed. OSHA 'permissible exposure limits' (PELs) for the 600 substances reflect all updates and changes as presented in the January 19, 1989 Federal Register. Volume 1 contains information on substances A-I, Volume 2 contains substances starting with K-Z.

52498 (PB–89-220545/XAB) **Commercial treatment/recovery TSDR (treatment, storage, disposal and recycling) survey data set.** Versar, Inc., Springfield, VA (USA). Jun 1989. 124p. Available from NTIS, PC A06/MF A01.

Portions of this document are not fully legible.

The commercial treatment/recovery capacity data set consists of data on Incineration/Reuse as Fuel and on Other Treatment Systems. The system capacity is data derived from data reported in the National Survey of Hazardous Waste Treatment, Storage, Disposal and Recycling Facilities, were entered onto PC data entry sheets.

52499 (PB–89-868038/XAB) **Waste-water treatment. June 1970-November 1987 (Citations from the COMPENDEX database). Report for June 1970-November 1987.** National Technical Information Service, Springfield, VA (USA). Aug 1989. 136p. Available from NTISPC N01/MF N01.

See also PB–89-868046.

This bibliography contains citations concerning techniques and equipment for the treatment of industrial (except mining) effluent streams. Consideration is given to the removal, reclamation, and recycling of various trace metals, heavy metals, hydrocarbons, and oily waste waters to meet regulatory agency discharge or in-plant reuse standards. (This updated bibliography contains 341 citations, none of which are new entries to the previous edition.)

52500 (PB–89-868046/XAB) **Wastewater treatment. December 1987-July 1989 (Citations from the COMPENDEX database). Report for December 1987-July 1989.** National Technical Information Service, Springfield, VA (USA). Aug 1989. 50p. Available from NTISPC N01/MF N01.

Supersedes PB–88-852975. See also PB–89-868038.

This bibliography contains citations concerning techniques and equipment for the treatment of industrial (except mining) effluent

streams. Consideration is given to the removal, reclamation, and recycling of various trace metals, heavy metals, hydrocarbons, and oily waste waters to meet regulatory agency discharge or in-plant reuse standards. (This updated bibliography contains 85 citations, all of which are new entries to the previous edition.)

3206 Municipalities and Community Systems

Refer also to citation(s) 52496, 53158, 53185, 53193, 53195, 53263

52501 (AD-A-209500/8/XAB) **Source-emission testing of classified-waste incinerator, Griffiss AFB, New York. Final report, 19-23 September 1988.** Scott, P.T. Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA). Apr 1989. 48p. (USAFOEHL-89-031EQ0079FEF). Available from NTIS, PC A03/MF A01.

At the request of 416 Strategic Hospital/SGPB, personnel of the AFOEHL Air Quality Function conducted source-emission testing for particulates, hydrogen chloride, and opacity on the classified-waste incinerator at Griffiss AFB. The New York Department of Environmental Conservation (NYDEC) required testing for permit compliance. Particulate emissions were well above the emission limits allowed by the State of New York. Action is recommended to bring the classified waste incinerator into compliance.

52502 (DOE/CE/26593-T1) **Desiccant-based, heat actuated cooling assessment for DHC systems: Quarterly report No. 1, May 1, 1989-July 31, 1989.** DiBella, F.; Patch, K.; Becker, F. TECOGEN, Inc., Waltham, MA (USA). Oct 1989. 14p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG01-89CE26593. Order Number DE90001201. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The goal of the project is to perform a conceptual design, systems analysis and case study evaluation of an application of a desiccant-based, heat actuated cooling system in a District Heating System. The results of this study will encourage the deployment of cooler transport temperatures in District Heating Systems. The proposed concept includes a liquid or solid desiccant-based air cooling and drying system that can be integrated with an existing HVAC system. 3 refs., 6 figs.

52503 (ORNL/FTR-2813) **[Investigation of consolidation and cost reduction programs for Thule Air Base]: Foreign trip report, February 1, 1988-February 5, 1988.** Nichols, J.P. Oak Ridge National Lab., TN (USA). 19 Feb 1988. 12p. Sponsored by U.S. Department of Defense. DOE Contract AC05-84OR21400. Order Number DE89017289. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Four members of the headquarters staff of the Air force Space Command, Steve Cohn of ORNL, and the author visited Thule AB to investigate a plan for consolidation and cost reduction at the base. an example plan was developed to show how third-party financing might be used to consolidate, modernize, and increase the cost effectiveness of the base. 9 refs., 2 figs., 4 tabs.

52504 (PB-89-197875/XAB) **Glass-contaminant removal from refuse-derived compost. Interim report. Report for April-July 1988.** New, R.; Papworth, R. Warren Spring Lab., Stevenage (UK). 1988. 24p. (LR-692(MR)M). Available from NTIS, PC EE03/MF E03.

This report details the test work carried out to investigate the feasibility of removing glass from fine (-20 mm) composted material derived from the putrescible (organic) rich fractions screened from unpulverized domestic refuse. Two options were examined, an air table and a vertical air classifier. However it is unlikely that a simple preprocessing stage exploiting density differences will produce a product which meets the proposed target EEC compost specifications for high value agricultural applications. In any case, if stringent specifications do become established or visual contamination (at any level) does inhibit market development it would seem sensible to investigate other separation or masking techniques so that a more esthetically appealing product is produced. Options that might be considered are sizing before processing, wet separation methods, comminution and/or pelletization.

52505 (PB-89-197974/XAB) **Investigation of pollutant emissions at sheffield municipal solid waste incinerator with assessment of long-term pollutant variability.** Scott, D.W. Warren Spring Lab., Stevenage (UK). 1988. 39p. (LR-675(PA)M). Available from NTIS, PC EE05/MF E05.

This report investigates pollutant pathways to the environment at Sheffield municipal-refuse incinerator, assesses the long-term variability of pollutant emissions at a single plant and compares these with pooled information from other UK incinerators. Stack emissions of particles, lead, hydrogen chloride, and carbon monoxide were not significantly different from those found at other UK plants, whereas sulfur dioxide and mercury emissions were significantly lower. Although paper char, cadmium, and dioxin emissions were generally lower at Sheffield than at other UK plants, it was not possible to make strict statistical comparisons as population variances were significantly different and data limited. Emissions from screened refuse were generally higher but in most cases the increases were not significant.

52506 (PB-89-198345/XAB) **Sampling and analysis of domestic refuse: A review of procedures at Warren Spring Laboratory. Report for January-August 1988.** Poll, A.J. Warren Spring Lab., Stevenage (UK). 1988. 45p. (LR-667(MR)M). Available from NTIS, PC EE05/MF E05.

This report describes and discusses the procedures used for the sampling and analysis of materials derived from domestic refuse by Warren Spring Laboratory. The procedures developed were adapted from existing classical and well documented methods used for mineral ores. They are similar to those developed and used by other groups of workers in Europe and the USA. Some attempts were made to establish national standards, but there are no international standards for these procedures. Consequently, it is concluded that there is a need for internationally agreed procedures for the sampling and analysis of refuse-derived materials.

52507 (PB-89-220578/XAB) **Analysis of US municipal-waste-combustion operating practices.** Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste. 18 May 1989. 139p. (EPA-530/SW-89/061). Available from NTIS, PC A07/MF A01.

This study presents the results of a nationwide survey of municipal waste combustion (MWC) facilities. The intent of the survey was to characterize the MWC industry as completely as possible. Topics covered include description of facilities, characterization of waste received, review of recycling activities, description of residue generation, and residue handling and disposal practices.

52508 **Thermal and biochemical options for advanced RDF technologies.** Walter, D.K. 29p. American Institute of Chemical Engineers, New York, NY (1988). (CONF-880348-: American Institute of Chemical Engineers spring national meeting, New Orleans, LA (USA), 6-10 Mar 1988).

Technical Paper 14H.

This report details the current commercial status of the use of Refuse-Derived Fuel (RDF) technologies and the future thermal and biochemical options. RDF is prepared by processing municipal solid waste to modify its size and to separate components which are not desirable. In the simplest form, RDF is sold as a solid fuel which displaces coal. However, coal is an inexpensive and plentiful energy source. Further, since RDF has a lower energy density than coal, substitute in existing boilers normally requires system derating. The options are to use combustion systems designed for RDF or emerging technologies which produce liquid or gaseous fuels. These conversion technologies may be either thermal or biochemical. Each system has a unique set of specifications that are imposed on the feedstock. In this paper the status of these advanced technologies and their preparation needs are discussed.

52509 **Densified RDF: Technologies and applications.** Ohlsson, O.O.; Lazar, J. 1p. American Institute of Chemical Engineers, New York, NY (1988). (CONF-880348-: American Institute of Chemical Engineers spring national meeting, New Orleans, LA (USA), 6-10 Mar 1988).

Technical Paper 14G.

Densified refuse-derived fuel (dRDF) is municipal solid waste (MSW) that has undergone several steps of sizing, separation and

screening to produce a refuse-derived fuel (RDF) and other soluble or recyclable by-products. The RDF is then densified in a pelletizing or cubing extrusion process. This dRDF product offers several advantages compared to RDF: ease and cost of transportation; increased storability; and the capability of firing in a variety of combustor configurations. This paper discusses the problems encountered with dRDF processing systems; the current status of dRDF facilities; technologies presently used; and the economics of existing systems.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3301 Internal Combustion Engines

Refer also to citation(s) 51718, 51729, 52362

52510 (AD-A–209412/6/XAB) **Heat-transfer measurements in a motored engine.** Yamada, S.; Paulsen, H.; Farrell, P. Wisconsin Univ., Madison, WI (USA). Mar 1989. 13p. Available from NTIS, PC A03/MF A01.

Pub. in International Congress and Exposition (27 Feb-3 Mar 1989).

A set of experiments was performed on a motored four-stroke engine measuring the gas phase thermal boundary layer profile adjacent to the cylinder head using speckle interferometry. Speckle interferometry is an optical technique that allows full-field, line-of-sight averaged optical phase shift measurements. These optical phase shift measurements may be interpreted as local temperature values for planar or axisymmetric geometries with ideal gases. For this set of experiments, a small (20-mm diameter) portion of the cylinder head was raised 2 mm above the rest of the surface and used as a test surface. The experiments were performed at two engine speeds, 300 and 750 RPM and at low and high intake swirl levels. Interferograms were obtained at 10 crank angle degree intervals from 70° before top dead center of compression to 60° after top dead center of compression. The results of these measurements are presented as temperature profiles in the boundary layer adjacent to the cylinder head surface, and as surface heat-flux estimates. The results of these measurements are compared to heat-flux-gage measurements in the same motored engine for one of the operating conditions.

52511 (NAL-TR–968) **Transonic operational characteristics and performance of two turbine-powered simulators determined from wind tunnel tests.** Koike, Akira; Asai, Keisuke; Hosoe, Nobuyuki; Karasawa, Toshio; Suenaga, Hisashi. National Aerospace Lab., Chofu, Tokyo (Japan). Mar 1988. 33p. (In Japanese). Order Number DE89772377. Available from NTIS (US Sales Only), PC A03/MF A01.

Power simulation is an indispensible condition for the wind tunnel test of the airflame in which the effect of the engine power governs the flight performance as with the case of STOL research airplane 'ASKA.' The turbine powered nacelle has an internally equipped TPS, and can be used for the widest range of simulation. 2m x 2m transonic wind tunnel was used for the test laying stress on 0.8 bar which is most frequently employed. The major dimensions, structure and shape of the nacelle are shown. Reports are made on the measurement of the pressures and temperatures inside the nacelle as well as on the measurement of the operational characteristics of TPS. Reports are made also on such items as the mass flow through the fan, magnitude of thrust and standadization. The details and result of the test are arranged into fan maps using the result of the TPS performance test. A little diffrence exists between the test results of the 2 TPS's. 6 references, 39 figures, 5 tables.

52512 (PB–89-215396/XAB) **Light-duty automotive technology and fuel-economy trends through 1989. Technical report.** Heavenrich, R.M.; Murrell, J.D. Environmental Protection Agency, Ann Arbor, MI (USA). May 1989. 57p. (EPA/AA/CTAB–89/04). Available from NTIS, PC A04/MF A01.

Supersedes PB–88-241914.

Trends in motor-vehicle technology and fuel-economy usage for light-duty cars and trucks model years 1978 through 1989 are examined in the report. Comparisons with previous years' data are made for the fleet as a whole and for the number of cylinders, vehicle class size, inertia weight class, and market segment (Domestic, European, and Asian).

3302 External Combustion Engines

Refer also to citation(s) 52362

52513 (ETDE-IT–89-13) **Prediction of leakage mass flow rate through gas springs.** Bossio, R.B.; Naso, V.; Cichy, M.; Pleszewski, B. Rome Univ. (Italy); Gdansk Univ. (Poland). Aug 1987. 5p. (CONF-870804–50: 22. intersociety energy conversion engineering conference, Philadelphia, PA (USA), 10-14 Aug 1987). Order Number DE89793131. Available from NTIS (US Sales Only), PC A02/MF A01.

A general analysis was carried out, which deals with gas spring performance simulation, with particular reference to free-piston Stirling-engine applications. As a previous proposal, on the assumption that losses due to gas leakage are negligible, an energy model was provided, together with an experimental method suitable for the evaluation of the convection heat transfer coefficient in the gas spring chamber. As a second step, this paper deals with a general energy model for the evaluation of gas flow through the clearances between the piston and the cylinder of the spring. In particular, the paper includes a description of the test bench suitable for the validation of the model, together with experimental investigations carried out in order to determine the parameters of the adopted energy model.

52514 (NEDOJ–8809, pp. 351-369) **Result and final evaluation of research and development of general-purpose Stirling engine.** Sakai, Yoshitake (Agency of Industrial Science and Technology, Tokyo,, Japan). New Energy Development Organization, Tokyo (Japan). 16 Sep 1988. (In Japanese). In *Proceedings of Parallel Sessions for the 8th NEDO General Assembly.* Available from NTIS (US Sales Only), PC A23/MF A01.

In the General Purpose Stirling Engine Development project, trial production and research for 3kW and 30kW class Stirling engines and the development of the applied systems are being carried on, with NEDO taking initiative in the project. The current status and achieved technological level are introduced. The evaluated result of the sealing technology is introduced which has a big effect on the durability and reliability. As regards the engine body, outlines of the final evaluation test, shaft horsepower, thermal efficiency, charateristics of exhaust gas, durability of the engine, dimension, weight, and achieved technological level are reported. As to the applied systems, air conditioning and electric power generation systems as well as the achieved technological level are reported. Use of a variety of fuels is a strong feature of the Stirling engine, and furthr research and development is expected to be done. Conditions are described which are required for the possibility of other applications than air conditioning and hot water supply. The future aspect of the stirling engine is also outlined. 5 figures, 5 tables.

52515 **Performance measurements for a diaphragm-coupled, free-piston Stirling engine heat pump module.** Ackermann, R.A. (Mechanical Technology Inc., Latham, NY (US)); Privon, G.T. vp of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y American Society of Mechanical Engineers, New York, NY (1988). (CONF-880702–: 23. intersociety energy conversion engineering conference, Denver, CO (USA), 31 Jul - 5 aug 1988).

Technical Paper 889039.

A free-piston Stirling engine heat pump (FPSE/HP) has been under development at Mechanical Technology Incorporated (MTI) for the past several years. Recent advances have enables a second-generation unit, the Mark I developed under GRI and DOE sponsorship, to achieve tis performance goals and sufficient reliability to be tested at an HVAC manufacturer's facility. The objectives of this testing were to provide an independent evaluation of the unit's performance under conditions similar to those used on electric heat pump compressors and to establish the unit's reliability outside

the research laboratory environment. Tests using an R-22 refrigerant calorimeter test loop were conducted at evaporator and condenser conditions simulating a wide range of ambient temperatures. The testing verified the performance measured at MTI and enabled a comprehensive set of operating/performance maps to be generated. The data from these tests are presented in this paper.

52516 **Evaluation of a magnetic coupling for hermetic power transmission in a Stirling-Rankine heat pump.** Chen, G. (Sunpower, Inc., Athens, OH (US)); Redlich, R.; Shade, D. vp of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y American Society of Mechanical Engineers, New York, NY (1988). (CONF-880702–: 23. intersociety energy conversion engineering conference, Denver, CO (USA), 31 Jul - 5 aug 1988).

Technical Paper 889040.

A free-piston Stirling engine-driven magnetically coupled heat pump are being investigated both analytically and experimentally. A test rig, including a motor/crankshaft/magnetic coupling/double-acting compressor assembly, was designed, fabricated, and tested. Calculated and measured properties of magnetic coupling intended for use with a free-piston Stirling engine-driven heat pump are presented. Parameters investigated were coupling force, losses, operating temperature, side forces, loss of magnetization of coupling magnets, and system resonances. The analytical model accurately predicted measured properties.

52517 **A historical perspective on Stirling engine performance.** West, C.D. (Oak Ridge National Lab., Oak Ridge, TN (US)). vp of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y American Society of Mechanical Engineers, New York, NY (1988). (CONF-880702–: 23. intersociety energy conversion engineering conference, Denver, CO (USA), 31 Jul - 5 aug 1988).

Technical Paper 889004.

A study of II Stirling engines designed between 1840 and 1985 shows a 2 to 3 orders of magnitude improvement in specific power over that period, a factor of 2 or 3 improvement in brake efficiency, and a factor of only 1.5 improvement in the ratio of indicated-to-Carnot efficiency. Free-piston engines generally appear to achieve a much lower fraction of their Carnot potential than do kinematic ones.

52518 **Liquid piston seals for Stirling machines.** West, C.D. (Oak Ridge National Lab., Oak Ridge, TN (US)). vp of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y American Society of Mechanical Engineers, New York, NY (1988). (CONF-880702–: 23. intersociety energy conversion engineering conference, Denver, CO (USA), 31 Jul - 5 aug 1988).

Technical Paper 889200.

Recently, Peter Tailer described a new form of Stirling engine that he called a plunging cylinder liquid piston engine. The principle consists of a cylinder moving past a loosely fitting, stationary piston. The piston is under water or some other appropriate liquid. The engine demonstrated by Tailer is very simple and works on a low-temperature difference with a low-pressure working fluid. This paper analyzes the power losses introduced by this type of piston seal (i.e., a piston sealed by liquid that can leak into or out of the working space under the influence of the cyclic pressure). A very simple equation is derived for the power loss. The potential for application of this principle to high-speed, high-pressure engines is briefly explored.

52519 **Design integration and test of a heat pipe heated 100-HP Stirling engine.** Merrigan, M.A. (Los Alamos National Lab. (US)); Runyan, J.E.; Sena, J.T.; Eaton, W.; Mikula, J. vp of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y American Society of Mechanical Engineers, New York, NY (1988). (CONF-880702–: 23. intersociety energy conversion engineering conference, Denver, CO (USA), 31 Jul - 5 aug 1988).

Technical Paper 889278.

Operational tests of a fluidized bed/Stirling engine/heat pipe power system have been conducted. Stainless steel, internally knurled heat pipes, operating at 1083 K with a maximum power throughput of 9.3 kW, were designed, fabricated, and tested for use in the power system. The integrated power system consists of a fluidized bed combustion system, a Stirling engine, and heat pipes as the heat transfer device between the fluidized bed and engine. The compact power system was developed for use with a variety of solid fuels. The combustion process operates in the temperature range of 1023-1249 K. Tests of the system have demonstrated the target capacity of 250 kW. Design and fabrication of the heat pipe heat transfer system and results of the system operation are presented in the paper.

52520 **C-CAMP, a Closed Cycle Alkali Metal Power system.** Wichner, R.P. (Engineering Technology Div., Oak Ridge National Lab., Oak Ridge, TN (US)); Hoffman, H.W. vp of Proceedings of the 23rd intersociety energy conversion engineering conference. Goswami, D.Y American Society of Mechanical Engineers, New York, NY (1988). (CONF-880702–: 23. intersociety energy conversion engineering conference, Denver, CO (USA), 31 Jul - 5 aug 1988).

Technical Paper 889192.

A concept is presented for a Closed-Cycle Alkali Metal (C-CAMP) power system which utilizes the heat of reaction of an alkali metal and halogen compound to vaporize an alkali metal turbine fluid for a Rankine cycle. Unique features of the concept are (1) direct contact (heat exchange) between the reaction products and turbine fluid, and (2) a flow-through chemical reactor/boiler. The principal feasibility issues of the concept relate to the degree of cross-mixing of product and turbine fluid streams within the reactor-boiler. If proven feasible, the concept may be adapted to a range for fuel and turbine fluids and ultimately lead to thermal efficiencies in excess of 35%.

3303 Electric-powered Systems

Refer also to citation(s) 52028

52521 (EGG-M–88114) **Derivation of synthetic mission profiles from electric vehicle field data.** Fink, R.K. EG and G Idaho, Inc., Idaho Falls, ID (USA). 1989. 5p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. (CONF-891133–1: 9. electric vehicle symposium, Toronto (Canada), 13-16 Nov 1989). Order Number DE89011125. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A method using Monte Carlo sampling has been developed for synthesizing prototypical time histories of velocity and power from mission summary data gathered with the on-board Versatile Data Acquisition Systems (VDAS). The basic approach is to construct a set of probability distributions for mechanical power in each velocity range of the VDAS data, from which power values are randomly sampled at each time step. The corresponding velocity changes are then calculated from the equations of motion, resulting in a time history of the desired length which should produce the same effects on vehicle systems as the (unknown) original vehicle operation. Some results are presented, and limitations of the process are discussed. 6 refs., 1 fig., 5 tabs.

3304 Hybrid Systems

Refer also to citation(s) 52521

3307 Emission Control

Refer also to citation(s) 51692, 51726, 52523, 53216

52522 (PB–89-201834/XAB) **Modeling ambient carbon monoxide trends to evaluate mobile-source emissions reductions.** Dennis, R.L.; Downton, M.W. Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab. 1987. 19p. (EPA–600/J-87/477). Available from NTIS, PC A03/MF A01.

Pub. in Jnl. of Climate and Applied Meteorology, Vol. 26, No. 10, 1377-1391(Oct 1987).

Regression models have been used with poor success to detect the effect of emission-control programs in ambient-concentration measurements of carbon monoxide. An advance CO regression

model is developed, based on an understanding of the physical processes of dispersion. Its performance is shown to be superior to the more traditionally developed regression and time-series models. The model reliably separates the effects of emissions change from the effects of fluctuations in meteorological conditions. The model has sufficient precision to identify present trends in emissions from ambient concentration data. The model should be useful for detecting changes in emission trends due to implementation of a control program on vehicular emissions such as an inspection and maintenance program.

3308 Alternative Fuels

Refer also to citation(s) 51729

52523 (PB–89-207906/XAB) **Durability testing of a Toyota LCS-M (lean combustion system-methanol) Carina. Technical report.** Piotrowski, G.K. Environmental Protection Agency, Ann Arbor, MI (USA). Office of Mobile Sources. Jun 1989. 30p. (EPA/AA/CTAB–89/03). Available from NTIS, PC A03/MF A01.

This report describes the exhaust emissions, fuel economy, and oil-sample analysis from a Toyota LCS-M Carina motor vehicle fueled with M100 fuel. The vehicle accumulated 6,000 miles driven over the AMA durability driving schedule in order to determine if exhaust-emissions levels increase during the first 5,000-15,000 miles of driving with a light-duty methanol-fueled vehicle. The program description, test-vehicle description, test facilities, and the test-vehicle specifications are included.

52524 (PB–89-210587/XAB) **Alternative transport fuels from natural gas. Technical paper.** Moreno, R.; Bailey, D.G.F. International Bank for Reconstruction and Development, Washington, DC (USA). 1989. 102p. (WORLD-BANK-TP–98). Available from NTISMF A01.

Library of Congress catalog card No. 89-34117; Microfiche copies only. Paper copy available from World Bank, 1818 H St., NW, Washington, DC 20433.

This report examines the economics of using natural gas as an alternative fuel in transport vehicles including passenger cars, taxis, buses, and trucks. It compares the cost of using conventional fuels (gasoline and diesel) in these vehicles with that of retrofitting the vehicles and using natural gas-based fuels. These fuels include compressed natural gas (CNG), liquefied petroleum gas (LPG), methanol, and synthetic gasoline and diesel. The analysis includes various scenarios to establish break-even points between these competing fuels under different assumptions.

35 ARMS CONTROL

3501 Policy, Negotiations, and Legislation

52525 (AD-A–209215/3/XAB) **United States national strategy and defense policy objectives after chemical disarmament. Study project.** Harrison, D.G.; Roberts, J.R. Army War Coll., Carlisle Barracks, PA (USA). 19 Mar 1989. 115p. Available from NTIS, PC A06/MF A01.

Negotiations on a chemical weapons ban treaty have shown remarkable progress in recent years, so much in fact that it appears some kind of agreement may be reached in the next few years. The focus of this study is to define United States National Security Strategy and Defense Policy Objectives after chemical disarmament is achieved. Data on the problem were collected through open literature and interviews with key officials in the Department of Defense, and Department of State, to include the Arms Control and Disarmament Agency. The study emphasizes the changing threat in the Third World, a phenomenon that has accelerated in the last years. While a total verifiable ban on chemical weapons is a laudable goal, the possibility of such a treaty achieving the complete elimination of chemical threats is distinctly remote. While the United States, Soviet Union and thirty-eight other countries participating in the 40-nation Chemical Disarmament Conference have agreed 'in principle', many problems remain. (JES)

52526 (AD-A–209229/4/XAB) **Political and technical verification issues of limitations on sea-launched cruise missiles. Master's thesis.** Myers, R.K. Naval Postgraduate School, Monterey, CA (USA). Mar 1989. 111p. Available from NTIS, PC A06/MF A01.

This paper examines the political and technical verification issues associated with proposals to place quantitative and/or qualitative limits on the deployment of nuclear-armed sea-launched cruise missiles (SLCMs). Overviews of the arms control relationship between the United States and the Soviet Union, the development of the SLCM, and Soviet and American concepts of verification are presented. The views of the American arms control and defense communities regarding the SLCM is discussed in depth, accompanied by a detailed examination of the various methods which have been proposed to verify a SLCM limitation agreement. The conclusion is that there are no technological barriers, per se, to SLCM verification, but as the decision on an agreement's verifiability is a political one, the U.S. Navy should concentrate its arguments against SLCM limitations on the weapon's operational utility rather than argue that such an agreement is unverifiable.

36 MATERIALS

52527 (IEIE–8802, pp. 4) **Plasma processing technology.** Ichikawa, Yukimi (Fuji Electric Corporate Research and Development Ltd., Kawasaki (Japan)); Sakai, Hiroshi. Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related to electricity and information.* Available from NTIS (US Sales Only), PC A02/MF A01.

In the so-called Semiconductor Plasma Processing Technology, discharge plasma is applied to the production of semiconductor devices. Plasma chemistry has been extensively studied, in which plasma is applied to polymerization for the formation of high molecular films. Plasma CVD and etching which are particularly important among the plasma processes are briefly explained Same kind of equipment can be used for the plasma CVD and plasma etching, the only difference between the 2 processing methods being etching and discharge conditions. A drawing is given which shows the principle of the plasma CVD in which electrodes of parallel flat plate structure are employed. Microwave discharge which needs no electode is aggressively applied recently for the processing. A device has been developed which utilizes electron cyclotron resonance as the plasma source, and has been used for the study of anistropic etching, insulation film formation in the room temperature, high speed film formation, etc. 11 references, 6 figures, 3 tables.

52528 (IEIE–8802, pp. 4) **Technology of processing and welding by plasma.** Hiramoto, Seigo (Mitsubishi Electric Corp, Tokyo (Japan)); Simada, Wataru. Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related toelectrical and infomation engineers, Japan.* Available from NTIS (US Sales Only), PC A02/MF A01.

Plasma arc has the power density of $10^5 W/cm^2$ and, together with electron beam and laser beam, is called the high energy source. It has been widely used as a heat source for welding, cutting and flame spraying. Plasma arc, plasma jet, and the intermediate system employing the first 2 systems are used for the generation of high temperature plasma. An example of the temperature distribution of plasma jet is shown. The temperatures are as high as above 30,000K near the cathode, and 10,000 - 16,000K in the groove being cut. The fact indicates that any kinds of materials can be melted. The quality of cutting and cutting phenomena are closely related, and setting of the cut conditions is required which will not result in dross adhesion. Key hole welding can be a representative plasma welding. The outline of the buildup welding is presented. 11 references, 11 figures.

52529 (IEIE–8802, pp. 4) **Plasma and energy technology.** Kojima,Yoshiyuki (Hitach, Ltd., Tokyo (Japan)); Onaka,Noriyuki. Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related to electricity and information.* Available from NTIS (US Sales Only), PC A02/MF A01.

Plasma spraying is picked out as an example for surface upgrading method utilizing thermo plasma, and the features and applications are introduced. The method has features, which are lacking in other technologies, such as wide selection of film materials including metals, ceramic, plastic, etc., film thickness ranging from several μ m to ten-odd mm, etc. The basic configuration of the low pressure plasma spray system is shown. High quality film containing no oxide scale can be obtained by the system because the spraying is made in a protected environment. Fine deposition and crystal grains can be obtained utilizaing the rapid quenching coagulation fuction of the flame spraying, making it possible to develop new materials which cannot be acquired by normally melted materials. High quality film with no oxide is used as anticorrosion and thermal insulation coating for high temperature parts in gas turbines and other equipment, and the plastic plasma spraying is an important technology for the reliability improvement of high temperature materials. 4 references, 10 figures, 1 table.

52530 (INIS-SU–122/A) **Crystal growth from melts. V. 3. Extended theses.** AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. 430p. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

Individual papers in scope for the data base are processed separately.

52531 (N–89-24626) **Research in structures, structural dynamics and materials, 1989.** Hunter, W.F.; Noor, A.K. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. Apr 1989. 88p. (NASA-CP–10024;NAS–1.55:10024;CONF-8904112–: 30. structures, structural dynamics and materials conference, Mobile, AL (USA), 3-5 Apr 1989). Available from NTIS, PC A05/MF A01.

Topics addressed include: composite plates; buckling predictions; missile launch tube modeling; structural/control systems design; optimization of nonlinear R/C frames; error analysis for semi-analytic displacement; crack acoustic emission; and structural dynamics.

3601 Metals and Alloys

Refer also to citation(s) 51620, 51650, 51651, 51652, 51753, 51788, 52137, 52138, 52139, 52164, 52248, 52250, 52284, 52483, 52858, 52864, 52874, 52934, 52962, 52963, 53029, 53654, 53900, 54009

52532 (AD-A–209316/9/XAB) **Characteristics of liquid-phase-sintered tungsten heavy alloys.** Rabin, B.H.; Bose, A.; German, R.M. Rensselaer Polytechnic Inst., Troy, NY (USA). 1989. 8p. Available from NTIS, PC A02/MF A01.

Pub. in The International Jnl. of Powder Metallurgy, Vol. 25, No. 1, 21-27(1989).

The tungsten heavy alloys are metal-metal composites produced by liquid-phase sintering of mixed tungsten, nickel, and iron powders. The tungsten single crystal grains are interconnected and the grain shape is adjusted to fill space. These alloys usually contain 80 to 98 wt.% tungsten, and exhibit a unique combination of high density, strength, and ductility. They are used extensively as kinetic energy penetrators as well as for intertial components, counterbalance weights, and radiation containers.

52533 (BNL–42450) **Flux creep in multifilamentary conductors of NbTi and Nb_3Sn.** Ghosh, A.K.; Xu, Youwen; Suenaga, M. Brookhaven National Lab., Upton, NY (USA). [1989]. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890701–9: International cryogenic materials conference, Los Angeles, CA (USA), 24-28 Jul 1989). Order Number DE90001327. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Long term decay of the sextupole field has been observed in accelerator dipole magnets, and this effect has been linked to "flux creep" in the superconductor. To study this problem, the decay of the magnetization of multifilamentary conductors of NbTi and Nb_3Sn have been measured as a function of time. Measurements show that as a function of Int this decay cannot always be characterized by a single decay rate. Long time decay rates are sometimes approximately half that which is observed at short times < 1000 secs. Creep rates are found to: (1) scale with filament diameter, (2) change slowly with field, (3) change rapidly as H is backed off from the critical state and (4) is fairly insensitive to temperature for $0.3T_c < T < 0.8T_c$. Results of this investigation are compared to sextupole field decay observed in magnets. 13 refs., 5 figs., 3 tabs.

52534 (BNL–43284) **Characterization of Rh films on Ta(110).** Jiang, L.Q.; Ruckman, M.W.; Strongin, M. Brookhaven National Lab., Upton, NY (USA). 1989. 21p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-891093–5: 36. American Vacuum Society national vacuum symposium, Boston, MA (USA), 23-27 Oct 1989). Order Number DE90001323. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The surface and electronic structure of Rh films on Ta(110) up to several monolayers thick on Ta(110) are characterized by photoemission, Auger emission, low energy electron diffraction and low energy ion scattering. From the variation of the Rh Auger peak-to-peak intensity as a function of evaporation time, Rh/Ta(110) appears to grow in the Stranski-Krastanov mode at room temperature. However, the LEIS data show that the Rh adatoms begin to cluster on Ta(110) before growth of the monolayer is completed. Diffuse LEED scattering suggests that the Rh films are disordered. Photoemission shows that Rh chemisorption on Ta(110) generates two peaks located at 1.2 and 2. 5 eV binding energy during the initial phase of thin film growth ($0 < \Theta < 0.5$ ML). By 0.75 ML Rh coverage, those states merge into a broad structure centered near 2 eV binding energy. Photoemission peaks typical of a Rh(111) surface are seen at higher coverages ($\Theta > 3.7$ ML). Photoemission data for CO covered surfaces show that CO dissociates on the Rh/Ta(110) surface for Rh coverages less than 2.5 ML and also show that the Rh clusters develop at least one site capable of molecular CO adsorption above 0.3 ML Rh coverage. 38 refs., 5 figs.

52535 (CEGB-TPRD/L–3284/R88) **Effects of ageing on the ductile fracture of AISI type 316 stainless steel.** Senior, B.A.; Havel, R.; Neale, B.K. Central Electricity Research Labs., Leatherhead (UK). Jun 1988. 19p. Order Number DE90606336. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The micromechanisms of ductile fracture have been studied in a commercial AISI type 316 austenitic stainless steel. Tensile, Charpy impact and ductile fracture toughness testing has been performed on unaged material and samples aged at 700°C for times up to 4380 h. Examination of the specimens after testing has demonstrated that the microstructural changes occurring at grain boundaries are reponsible for the observed losses of ductility and crack growth resistance. The relative magnitude of the observed changes in mechanical properties has been accounted for using a simple model to describe the ductile fracture process. (author).

52536 (CONF-880732–3) **Laser Raman Spectroscopy in studies of corrosion and electrocatalysis.** Melendres, C.A. Argonne National Lab., IL (USA). [1988]. 43p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. From Spectroscopic and diffraction techniques in interfacial electrochemistry; Puerto de la Cruz (Spain); 3-15 Jul 1988. Order Number DE90001414. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Laser Raman Spectroscopy (LRS) has become an important tool for the in-situ structural study of electrochemical systems and processes in recent years. Following a brief introduction of the experimental techniques involved in applying LRS to electrochemical systems, we survey the literature for examples of studies in the inhibition of electrode reactions by surface films (e.g., corrosion and passivation phenomena) as well as the acceleration of reactions by electro-sorbates (electrocatalysis). We deal mostly with both normal

and resonance Raman effects on fairly thick surface films in contrast to surface-enhanced Raman investigations of monolayer adsorbates, which is covered in another lecture. Laser Raman spectroelectrochemical studies of corrosion and film formation on such metals as Pb, Ag, Fe, Ni, Co, Cr, Au, stainless steel, etc. in various solution conditions are discussed. Further extension of the technique to studies in high-temperature and high-pressure aqueous environments is demonstrated. Results of studies of the structure of corrosion inhibitors are also presented. As applications of the LRS technique in the area of electrocatalysis, we cite studies of the structure of transition metal macrocyclic compounds, i.e., phthalocyanines and porphyrins, used for catalysis of the oxygen reduction reaction. 104 refs., 20 figs.

52537 (CONF-891024–2) **Nickel beryllides and their properties.** Nieh, T.G.; Wadsworth, J.; Liu, C.T. Oak Ridge National Lab., TN (USA). 1989. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From The Metallurgical Society fall meeting: materials week; Indianapolis, IN (USA); 1-5 Oct 1989. Order Number DE90001736. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The elastic properties of nickel beryllide have been evaluated from room temperature to 1000°C. The room temperature modulus is measured to be 186 GPa which is relatively low by comparison with other B2 aluminides such as NiAl and CoAl. Hardness measurements were carried out on specimens that had compositions over the range from 49 to 54 at. % Be, using both a Vickers microhardness tester and a nanoindentor. It was found that the hardness of NiBe exhibits a minimum at the equiatomic composition. This behavior is similar to that of aluminides of the same crystal structure, e.g., NiAl and CoAl. The effect of interstitial oxygen on the hardness of NiBe has also been studied and the results show that the presence of oxygen in NiBe can cause a significant increase in hardness. It is demonstrated that the hardness increase for the off-stoichiometric compositions is primarily caused by interstitial oxygen and can only be attributed partially to anti-site defects generated in off-stoichiometric compositions. Oxidation properties of both equiatomic NiBe and pure Be were characterized at temperatures ranging from 800 to 1200°C. At temperatures below 1100°C, nickel beryllide formed a thin, protective BeO scale and exhibited excellent oxidation resistance. The good oxidation resistance is believed to be a result of the small lattice mismatch between BeO and NiBe. The effect of oxygen partial pressure on the oxidation of NiBe was also evaluated. 25 refs., 9 figs., 1 tab.

52538 (CONF-8904275–) **Ion beam processing of advanced electronic materials.** Cheung, N.W.; Marwick, A.D.; Roberto, J.B. (eds.). Oak Ridge National Lab., TN (USA). [1989]. 393p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Symposium on ion beam processing of advanced electronic materials; San Diego, CA (USA); 25-27 Apr 1989. Order Number DE89017342. Available from NTIS, PC A17/MF A01; OSTI; INIS; GPO Dep.

This report contains research programs discussed at the materials research society symposia on ion beam processing of advanced electronic materials. Major topics include: shallow implantation and solid-phase epitaxy; damage effects; focused ion beams; MeV implantation; high-dose implantation; implantation in III-V materials and multilayers; and implantation in electronic materials. Individual projects are processed separately for the data bases. (CBS)

52539 (DP-MS–89-41) **Helium-induced weld cracking in irradiated 304 stainless steel.** Birchenall, A.K. Westinghouse Savannah River Co., Aiken, SC (USA). 1989. 27p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-891024–3: The Metallurgical Society fall meeting: materials week, Indianapolis, IN (USA), 1-5 Oct 1989). Order Number DE90001312. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report consists of slide notes for presentation to The Metallurgical Society of the American Institute of Mining, Metallurgical and Petroleum Engineers (AIME). The meeting in question will be held October 3, 1989 in Indianapolis. This presentation will be the second of three consecutive talks contributed by SRL personnel dealing with helium-induced weld cracking.

52540 (ENEA-RT-TIB–88-15) **New approach to the thermodynamics of condensed matter. Part 1. The specific heat, at constant pressure, of metals.** Tosto, S. ENEA, Casaccia (Italy). Dipt. Tecnologie Intersettorialli di Base. Jul 1988. 65p. (CONF-8603260–: 6. general conference of the Condensed Matter Division of the EPS, Stockholm (Sweden), 22-26 Mar 1986). Order Number DE89761839. Available from NTIS (US Sales Only), PC A04/MF A01.

The paper describes a theory concerning the lattice specific heat, at constant pressure, of metals. The theory is based on the assumption that the heat exchanges are due to the exchange of heat particles, whose existence is introduced as a postulate. The physical meaning of these particles is described through the Heisenberg's uncertainty principle and the first law of thermodynamics. On the basis of such and initial hypothesis, the possible energy states of matter in the presence of these particles were calculated by means of Fermi-Dirac and Bose-Einstein statistics. As consequence, an expression for the lattice specific heat at constant pressure was deduced. A very good agreement with experimental data was found. Moreover, several results consistent with well established concepts of physics were deduced as a natural corollary of the theory. It was also found that the temperature is a quantized amount; it can change by steps of about 7x10(-26) K degrees.

52541 (ETDE-IT–89-07) **Gold recovery from acidic leach solutions using as extractants trialkylamines of N,N'-di-alkyl-aliphatic amides.** Baroncelli, F.; Carlini, D.; Gasparini, G.M.; Simonetti, E. ENEA, Casaccia (Italy). Centro Ricerche Energia. Jul 1988. 4p. (CONF-8807136–: ISEC '88: international solvent extraction conference, Moscow (USSR), 18-24 Jul 1988). Order Number DE89793123. Available from NTIS (US Sales Only), PC A02/MF A01.

TriOctylAmine (TOA) and a di-substituted aliphatic amide, N,N-Di-N-ButylOctanamide (DBOA), were examined in batch and in mini mixer-settler experiments using leachates of Peruvian and Bolivian concentrates. With these minerals, very rich in sulfur (pyrites, stybine), 90-95% gold recovery in 12-24 hours was reached by leaching with 4M aqua regia (HCl 3M nitric acid 1M) at room temperature and with 1/3 solid/liquid ratio. With these leachate solutions (2-3M total acidity, 10-60 ppm ao Au), the two processes with TOA (GAMEX PROCESS) and with DBOA (AUMIDEX PROCESS) were tested and compared. Experimental results strongly support the possibility of using TOA and DBOA on an industrial scale.

52542 (HEDL–7639) **Effects of neutron irradiation to 63 dpa on the properties of various commercial copper alloys.** Brager, H.R. Westinghouse Hanford Co., Richland, WA (USA). Apr 1986. 12p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-87RL10930. Order Number DE90001131. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objective of this effort is to determine the effect of high neutron fluence on the properties of high purity copper and of a range of conventional commercial high-conductivity, high-strength, copper-base alloys. High purity copper and six commercial copper alloys were neutron irradiated to 47 and 63 dpa at about 450°C in the FFTF. Immersion density measurements showed a wide range of swelling behavior after irradiation to 63 dpa. At one extreme was CuBe in the aged and tempered (AT) condition which had densified slightly. At the other extreme was 20% CW Cu–0.1% Ag which swelled over 45%. Electrical resistivity measurements of high-conductivity alloys followed trends similar to previously published results for the same alloys irradiated to 16 dpa, namely a continued reduction in conductivity with fluence which appears to relate to transmutation products and, somewhat, to void formation and defect cluster development. The reduction was to a value comparable with that of the irradiated Cu–Al25 — the Al_2O_3 dispersion strengthened alloy. Conversely, for the moderate conductivity alloy CuBe, the electrical conductivity was unaffected for irradiation greater than 16 dpa. These results of the irradiated material were compared with electrical conductivity of unirradiated alloys examined after aging for 10,000 hours. 6 refs., 9 figs., 1 tab.

52543 (IEIE–8802, pp. 4) **Generation and application of nitrogen beam.** Akagami, Masayasu (Nissin Electric Co. Ltd., Kyoto (Japan)); Sakai, Shigeki; Yamaki, Hiroki; Nakato, Takahiro; Ogata, Kiyoshi; Ando, Yasunori; Goino, Youichi. Institute of Electrical and

Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related toelectrical and information engineers Japan.* Available from NTIS (US Sales Only), PC A02/MF A01.

Technology of extracting ion in beam form from nitrogen plasma to irradiate it to objects is introduced. Ion (plasma) nitriding method to nitride and harden the surface of ferrous metals is compared with nitrogen beam implantation method. The features of the beam application methods, with the ion implantation method as the representative one, are the possibility of implanting required amount into desired depth, implanting only the desired kind of ion avoiding impurities from the conainer wall, and accurate controlling of the implantation location, implantation direction and the amount of dose. The demerits are the complexity of the device, large size, expensive device and power source, and requirements for elaboration in holding, installing and irradiating the objects. Ion beam devices presently available are introduced. Some of the examples of new functions added to the materials obtained by the use of ion beam are introduced, limiting the field to nitrogen beam only. 10 references, 13 figures, 1 table.

52544 (INIS-BR–1650) **Influence of short range chemical order on density of states in α-ZrNi.** Duarte Junior, J. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. 1986. 98p. (In Portuguese). Order Number DE90606340. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

Calculations of the density of electronic states for amorphous alloys of ZrNi and ZrCu with different chemical order degrees, in order to verify the effect of chemical ordering on this property, are presented. The results obtained for ZrCu shown that the density of states at Fermi level do not vary significantly with the ordering. The results for ZrNi shown that the introduction of short range chemical order can decrease significantly the density of states at Fermi level, leading to better agreement with experimental results. (M.C.K.).

52545 (INIS-BR–1682) **Characterization and sintering of ATR aluminia from niobium.** Shibuya, N.H. Universidade Estadual de Campinas, SP (Brazil). Inst. de Fisica. 1987. 113p. (In Portuguese). Order Number DE90606327. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

The characterization of resultante slag from Aluminothermic Reduction (ATR) process to obtain metallic niobium is presented. The slag was characterized for concentration and phases of aluminia by X-ray diffractometry. The results show that 70% of the slag is constituted by α aluminia. The lixiviation and calcination of the slag increased the α aluminia concentration to 95%, the slag was used for producing samples to be burning in three furnaces: electrical resistance furnace in the air, and two furnaces in the vacuum. The burned samples were characterized by microscopy, ultrasonic analysis, density measurements and X-ray diffractometry. The sintering in the vacuum is possible because the samples burned in vacuum presented major density. The formation of NbO_2 and mullite was observed, by X-ray diffractometry. The data from optical microscopy, density measurements and X-ray diffractometry show high porosity. (M.C.K.).

52546 (INIS-SU–122/A, pp. 80-81) **Growing of tungsten tubular crystals by electron beam zone melting.** Glebovskij, V.G. (AN SSSR, Chernogolovka (USSR). Inst. Fiziki Tverdogo Tela); Semenov, V.N.; Lomejko, V.V. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth, Moscow (USSR), 14 Nov 1988). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.
T-14397.

Short note. 1 ref. TUNGSTEN/crystal growth; DIMENSIONS; GEOMETRY; IMPURITIES; MONOCRYSTALS; POLYCRYSTALS; TUBES; TUNGSTEN; ZONE MELTING

52547 (INIS-SU–122/A, pp. 302-303) **Regularities of growth twin formation during zinc and cadmium monocrystal growing from melt. 4.** Kazarov, Yu.G. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. Nizkikh Temperatur); Lavrent'ev, F.F. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–:). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.
T-14397.

Short note. 2 refs. CADMIUM/crystal growth; CADMIUM/twinning; CADMIUM; TWINNING; MONOCRYSTALS; ORIENTATION; ZINC

52548 (INIS-SU–122/A, pp. 329-330) **Investigation of crystal perfection for Sb_2Te_3 base solid solutions using electron channeling pictures in scanning electron microscope.** Ivanova, L.D. (AN SSSR, Moscow (USSR). Inst. Metallurgii); Konstantinova, M.S.; Granatkina, Yu.V. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth, Moscow (USSR), 14 Nov 1988). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.
T-14397.

Short note. 1 ref. ANTIMONY TELLURIDES/crystal defects; ANTIMONY TELLURIDES/czochralski method; BISMUTH TELLURIDES; MONOCRYSTALS; ORIENTATION; SCANNING ELECTRON MICROSCOPY; SOLID SOLUTIONS

52549 (IPEN-PUB–257) **Study and development of a system for the determination of porus plates permeability.** Leitao Junior, C.B.; Zorzetto, L.F. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Jul 1989. 17p. (In Portuguese). Order Number DE90606337. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A device employed for the study of flux in porous media and another one employed for the determination of permeability of porous plate are presented in this work. Experimental data and calculation obtained from the above cited systems are also presented. (author).

52550 (KY/L–1549) **Cracking of 1-inch UF_6 cylinder valve packing nuts: The effects of packing nut torque on stem seal leakage and packing nut stress due to thermal expansion of the PTFE stem seal rings.** Davis, S.J.; Underwood, D.E. Paducah Gaseous Diffusion Plant, KY (USA). 21 Aug 1989. 25p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OU21400. Order Number DE90001406. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A series of tests has been conducted to correlate the torque applied to the packing nut of 1-in. uranium hexafluoride (UF_6) cylinder valves versus the stem seal leak rate and material strain. The tests were initiated as a result of discussions held at the 1989 spring meeting of the American National Standards Institute (ANSI) N14.1 committee. The packing nut has been observed to fail due to stress corrosion cracking. The specified level of torque applied to the packing nut to seal the stem packing has been suspected to be a contributor to the failures. The ANSI standard specifies torque of 120 to 150 ft-lb to compact the PTFE packing rings. One series of tests measured the effects of reduced levels of packing nut torque to the stem seal leak rate. The bubble leak rate of the stem was measured at ambient and 225°F temperature with the body interior at 75 psig. Results from the laboratory tests indicate that the stem seal will perform acceptably through multiple thermal excursions at a torque level as low as 50 ft-lb. The second series of tests measured the effect of thermal expansion and increased hydrostatic force of the PTFE rings on the packing nut strain. The strain at certain exterior locations on a packing nut was measured at ambient and elevated temperatures for various assembly torques. The net increase in material strain is significant and is nearly equal at torque levels of 55, 85, and 115 ft-lb, being −479, −463, and −469 μin. respectively.

52551 (LA-UR–89-3123) **Strengthening mechanisms of tungsten powder reinforced uranium.** Lewis, M.A.K.; Hill, M.A.; Rollett, A.D.; Dunn, P.S.; Mortensen, A. Los Alamos National Lab., NM (USA). 1989. 19p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-36. (CONF-8910240–1: Fundamental relationships between microstructure and mechanical properties of

metal matrix composites, Indianapolis, IN (USA), 1-5 Oct 1989). Order Number DE90001828. Available from NTIS, PC A03/MF A01 - OSTI.

Tungsten powder reinforced uranium exhibits a three-fold increase in yield strength due to precipitation hardening. The tungsten-rich interphase precipitates form at moving phase boundaries during slow cooling. Further increases in yield strength, attained with increasing tungsten content, are due to composite strengthening; this is verified by increasing elastic modulus with increasing tungsten content. Age hardening behavior is observed, with strengthening occurring at aging temperatures low in the alpha phase. Aging higher in alpha gives initial strengthening followed by rapid overaging. Beta phase aging results in a very soft structure with precipitates visible optically. Wrought material exhibits significant strain hardening as well as composite strengthening due to elongation of the tungsten particles. 7 refs., 15 figs., 4 tabs.

52552 (LBL–27381) **Cryogenic mechanical properties of low density superplastic Al-Mg-Sc alloys.** Verzasconi, S.L.; Morris, J.W. Jr. Lawrence Berkeley Lab., CA (USA). Jun 1989. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890701–13: International cryogenic materials conference, Los Angeles, CA (USA), 24-28 Jul 1989). Order Number DE90002120. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Spacecraft cryogenic fuel tankage made from superplastic materials is a possible new application for low density aluminum alloys such as Al-Mg-Sc. Examples from this alloy system were examined for cryogenic strength and toughness. Alloys studied were received in the superplastically formable condition, in sheet form. Alloy 2219-T87 sheet was also tested for comparison, since 2219-T8X is currently used in cryogenic tankage. Five compositions of Al-Mg-Sc alloys were tested at 77 and 4 K. Alloys showed the expected increase in strength with decreasing temperature, accompanied by a generał slight decrease in elongation and the Kahn tear-yield ratio toughness indicator; however, the strength-tear toughness relationship of this alloy class was as good as or better than that of 2219-T87. Correlations found between the properties, microstructure, and fracture surfaces are discussed. 8 refs., 1 fig., 3 tabs.

52553 (LBL–27607) **The strength-toughness combination of the aluminum-lithium alloys 2090 and 2091 at cryogenic temperatures.** Glazer, J. Lawrence Berkeley Lab., CA (USA). Jul 1989. 168p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE90001425. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

The strength-toughness combination of the aluminum-lithium alloys 2090 (nominal composition Al-2.7 Cu-2.2 Li-0.1 Zr in wt %) and 2091 (Al-2.2 Cu-2.0 Li-1.5 Mg-0.1 Zr) plate at cryogenic temperatures was investigated. Aluminum-lithium alloys have lower density and higher stiffness than conventional aluminum alloys and were developed for aircraft applications. This study was motivated by the possibility of using aluminum-lithium alloys for cryogenic tankage of spacecraft, an application in which light weight, weldability and good cryogenic mechanical properties are at a premium. Alloy 2090-T81 has a strength-toughness combination that improves with decreasing temperature between 300 and 4 K under some conditions. This improvement is accompanied by an increase in the tensile elongation and strain hardening rate, but the large increase in fracture toughness is not reflected in the primary fracture mode. The goal of this study was to develop an understanding of the mechanisms responsible for the increase in fracture toughness at cryogenic temperatures. The mechanical properties of alloy 2090 in other metallurgical conditions and a second alloy, 2091, were also considered. Several mechanisms for interpreting the increased toughness in in-plane orientations at low temperatures were considered.

52554 (N–89-23528) **NASA/SDIO Space Environmental Effects on Materials Workshop, part 1.** Teichman, L.A.; Stein, B.A. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. May 1989. vp. (NASA-CP–3035-PT-1;L–16575-PT-1;NAS–1.55:3035-PT-1;CONF-8806434–: NASA/SDIO space environmental effects on materials workshop, Hampton, VA (USA), 28 Jun - 1 jul 1988). Available from NTIS, PC A16/MF A01.

The present state of knowledge regarding space environmental effects on materials is described and the knowledge gaps that prevent informed decisions on the best use of advanced materials in space for long-duration NASA and Strategic Defense Initiative Organization (SDIO) missions are identified. Establishing priorities for future ground-based and space-based materials research was a major goal. The end product was an assessment of the current state-of-the-art in space environmental effects on materials in order to develop a national plan for spaceflight experiments.

52555 (N–89-23528, pp. 5-24) **Overview of environmental factors.** Purvis, C.K. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. May 1989. (NASA-CP–3035-PT-1;L–16575-PT-1;NAS–1.55:3035-PT-1;CONF-8806434–: NASA/SDIO space environmental effects on materials workshop, Hampton, VA (USA), 28 Jun - 1 jul 1988). In *NASA/SDIO Space Environmental Effects on Materials Workshop, part 1.* Available from NTIS, PC A16/MF A01.

The orbital environment is complex, dynamic, and comprised of both natural and system-induced components. Several environment factors are important for materials. Materials selection/suitability determination requires consideration of each and all factors, including synergisms among them. Understanding and evaluating these effects will require ground testing, modeling, and focused flight experimentation.

52556 (N–89-23528, pp. 75-86) **Environmental effects on spacecraft materials.** Haffner, J.W. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. May 1989. (NASA-CP–3035-PT-1;L–16575-PT-1;NAS–1.55:3035-PT-1;CONF-8806434–: NASA/SDIO space environmental effects on materials workshop, Hampton, VA (USA), 28 Jun - 1 jul 1988). In *NASA/SDIO Space Environmental Effects on Materials Workshop, part 1.* Available from NTIS, PC A16/MF A01.

The effects of the natural space environments on materials are presented, which may be used for SDI applications. The current state-of-the-art knowledge of those effects was studied, and a literature search, a questionnaire mailing, and some visits to NASA and Air Force research facilities were performed. Phase 2 will be a study of what materials may be used for SDI applications and to what natural space environments they may be vulnerable. Deficiencies in knowledge of the effects of the natural space environments on these materials are to be identified and recommendations are to be made to eliminate these knowledge deficiencies.

52557 (N–89-23528, pp. 179-195) **Environmental definition of the earth's neutral atmosphere.** Visentine, J.T. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. May 1989. (NASA-CP–3035-PT-1;L–16575-PT-1;NAS–1.55:3035-PT-1;CONF-8806434–: NASA/SDIO space environmental effects on materials workshop, Hampton, VA (USA), 28 Jun - 1 jul 1988). In *NASA/SDIO Space Environmental Effects on Materials Workshop, part 1.* Available from NTIS, PC A16/MF A01.

Although number densities are low at altitudes where spacecraft typically operate, high orbital speeds result in incident fluxes and collisional energies large enough to interact with and degrade material surfaces. Global thermospheric models, when combined with orbital mechanics models, may be used to predict atomic oxygen fluence, or total integrated flux incidence on spacecraft sentences. Fluence predictions, when used with STS materials reactivity measurements, provide reliable estimates of the oxidative effects on spacecraft surfaces.

52558 (N–89-23528, pp. 197-239) **Atomic oxygen effects on materials.** Banks, B.A. (Ohio Univ., Athens (USA)); Rutledge, S.K.; Brady, J.A.; Merrow, J.E. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. May 1989. (NASA-CP–3035-PT-1;L–16575-PT-1;NAS–1.55:3035-PT-1;CONF-8806434–: NASA/SDIO space environmental effects on materials workshop, Hampton, VA (USA), 28 Jun - 1 jul 1988). In *NASA/SDIO Space Environmental Effects on Materials Workshop, part 1.* Available from NTIS, PC A16/MF A01.

Understanding of the basic processes of atomic oxygen interaction is currently at a very elementary level. However, measurement of erosion yields, surface morphology, and optical properties for low fluences have brought about much progress in the past decade.

Understanding the mechanisms and those factors that are important for proper simulation of low Earth orbit is at a much lower level of understanding. The ability to use laboratory simulations with confidence to quantifiably address the functional performance and durability of materials in low Earth orbit will be necessary to assure long-term survivability to the natural space environment.

52559 (N–89-23528, pp. 257-280) **The long-term effects of the micrometeoroid and orbital debris environments on materials used in space.** Cour-Palais, B.G. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. May 1989. (NASA-CP–3035-PT-1;L–16575-PT-1;NAS–1.55:3035-PT-1;CONF-8806434–: NASA/SDIO space environmental effects on materials workshop, Hampton, VA (USA), 28 Jun - 1 jul 1988). In *NASA/SDIO Space Environmental Effects on Materials Workshop, part 1.* Available from NTIS, PC A16/MF A01.

The long-term effects of the orbital debris and micrometeoroid environments on materials that are current candidates for use on space vehicles are discussed. In addition, the limits of laboratory testing to determine these effects are defined and the need for space-based data is delineated. The impact effects discussed are divided into primary and secondary surfaces. Primary surfaces are those that are subject to erosion, pitting, the degradation and delamination of optical coatings, perforation of atomic oxygen erosion barriers, vapor coating of optics and the production of secondary ejecta particles. Secondary surfaces are those that are affected by the result of the perforation of primary surfaces, for example, vapor deposition on electronic components and other sensitive equipment, and the production of fragments with damage potential to internal pressurized elements. The material properties and applications that are required to prevent or lessen the effects described, are defined.

52560 (N–89-23528, pp. 301-327) **Microparticle impacts in space: Results from Solar Max and shuttle witness plate inspections.** Mckay, D.S. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. May 1989. (NASA-CP–3035-PT-1;L–16575-PT-1;NAS–1.55:3035-PT-1;CONF-8806434–: NASA/SDIO space environmental effects on materials workshop, Hampton, VA (USA), 28 Jun - 1 jul 1988). In *NASA/SDIO Space Environmental Effects on Materials Workshop, part 1.* Available from NTIS, PC A16/MF A01.

The Solar Maximum Satellite developed electronic problems after operating successfully in space for several years. Astronauts on Space Shuttle mission STS-41C retrieved the satellite into the orbiter cargo bay, replaced defective components, and re-deployed the repaired satellite into orbit. The defective components were returned to Earth for study. The space-exposed surfaces were examined. The approach and objectives were to: document morphology of impact; find and analyze projectile residue; classify impact by origin; determine flux distribution; and determine implications for space exposure. The purpose of the shuttle witness plate experiment was to detect impacts from PAM D2 solid rocket motor; determine flux and size distribution of particles; and determine abrasion effects on various conditions. Results are given for aluminum surfaces, copper surfaces, stainless steel surfaces, Inconel surfaces, and quartz glass surfaces.

52561 (N–89-23547) **NASA/SDIO Space Environmental Effects on Materials Workshop, part 2.** Teichman, L.A.; Stein, B.A. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. May 1989. vp. (NASA-CP–3035-PT-2;L–16575-PT-2;NAS–1.55:3035-PT-2;CONF-8806434–: NASA/SDIO space environmental effects on materials workshop, Hampton, VA (USA), 28 Jun - 1 jul 1988). Available from NTIS, PC A12/MF A01.

The National Aeronautics and Space Administration (NASA) and the Strategic Defense Initiative Organization (SDIO) cosponsored a workshop on Space Environmental Effects on Materials. The joint workshop was designed to inform participants of the present state of knowledge regarding space environmental effects on materials and to identify knowledge gaps that prevent informed decisions on the best use of advanced materials in space for long duration NASA and SDIO missions. Establishing priorities for future ground based and space based materials research was a major goal of the workshop. The end product of the workshop was an assessment of the current state-of-the-art in space environmental effects on materials in order to develop a national plan for spaceflight experiments.

52562 (N–89-23547, pp. 425-446) **Ultraviolet radiation effects.** Slemp, W.S. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. May 1989. (NASA-CP–3035-PT-2;L–16575-PT-2;NAS–1.55:3035-PT-2;CONF-8806434–: NASA/SDIO space environmental effects on materials workshop, Hampton, VA (USA), 28 Jun - 1 jul 1988). In *NASA/SDIO Space Environmental Effects on Materials Workshop, part 2.* Available from NTIS, PC A12/MF A01.

Solar ultraviolet testing was not developed which will provide highly accelerated (20 to 50X) exposures that correlate to flight test data. Additional studies are required to develop an exposure methodology which will assure that accelerated testing can be used for qualification of materials and coatings for long duration space flight. Some conclusions are listed: Solar UV radiation is present in all orbital environments; Solar UV does not change in flux with orbital altitude; UV radiation can degrade most coatings and polymeric films; Laboratory UV simulation methodology is needed for accelerated testing to 20 UV solar constants; Simulation of extreme UV (below 200 nm) is needed to evaluate requirements for EUV in solar simulation.

52563 (N–89-23547, pp. 511-534) **Surface phenomena in plasma environments.** Purvis, C.K.; Ferguson, D.C. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. May 1989. (NASA-CP–3035-PT-2;L–16575-PT-2;NAS–1.55:3035-PT-2;CONF-8806434–: NASA/SDIO space environmental effects on materials workshop, Hampton, VA (USA), 28 Jun - 1 jul 1988). In *NASA/SDIO Space Environmental Effects on Materials Workshop, part 2.* Available from NTIS, PC A12/MF A01.

Plasma interactions and their effects on materials depend on a number of factors, including the pre-existing environment, the properties of surface materials and the characteristics of the system. An additional dimension is the question of mission: some payloads may be much more sensitive to plasma interactions than others. As an example, a payload whose objective is to measure the ambient environment will be more sensitive to any effects than will a power system. Material specific effects include charging and its associated effects, which can result in short- and long-term damage. Selection of materials for a particular application requires consideration of all factors and assessment of effects due to all causes. Proper selection and suitability determination requires analysis to identify the actual environment combined with testing under exposure to single and combined environment factors.

52564 (N–89-23547, pp. 545-552) **Atomic oxygen.** Leger, L.J.; Visentine, J.T. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. May 1989. (NASA-CP–3035-PT-2;L–16575-PT-2;NAS–1.55:3035-PT-2;CONF-8806434–: NASA/SDIO space environmental effects on materials workshop, Hampton, VA (USA), 28 Jun - 1 jul 1988). In *NASA/SDIO Space Environmental Effects on Materials Workshop, part 2.* Available from NTIS, PC A12/MF A01.

The effects of atomic oxygen (AO) on materials in aerospace environments are examined. Materials are categorized according to their susceptibility to AO. The degradation effects of AO are examined to determine which materials are most vulnerable. Classes of spacecraft materials are listed and correlated with a performance category. The spacecraft orbits sensitive to AO interactions are also listed. Correlations are presented of AO effects on materials and of spacecraft glow effects.

52565 (N–89-23547, pp. 553-557) **Micrometeoroids and debris.** Potter, A. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. May 1989. (NASA-CP–3035-PT-2;L–16575-PT-2;NAS–1.55:3035-PT-2;CONF-8806434–: NASA/SDIO space environmental effects on materials workshop, Hampton, VA (USA), 28 Jun - 1 jul 1988). In *NASA/SDIO Space Environmental Effects on Materials Workshop, part 2.* Available from NTIS, PC A12/MF A01.

The materials with vulnerability to micrometeoroids and space debris are discussed. It is concluded that all materials are vulnerable to hypervelocity impacts and that the importance of these impacts depends on the function of material. It is also concluded that low earth

orbits are the most significant region relative to orbital debris. The consequences of aerospace environment effects are discussed.

52566 (N–89-23547, pp. 573-575) **Solar radiation.** Slemp, W.S. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. May 1989. (NASA-CP–3035-PT-2;L–16575-PT-2;NAS–1.55:3035-PT-2;CONF-8806434–: NASA/SDIO space environmental effects on materials workshop, Hampton, VA (USA), 28 Jun - 1 jul 1988). In *NASA/SDIO Space Environmental Effects on Materials Workshop, part 2.* Available from NTIS, PC A12/MF A01.

The effects of solar radiation in aerospace environments on aerospace systems are examined. It was concluded that most materials degrade to solar radiation. The information available on short term effects on materials provides a limited data base. Flight data on coating degradation seems to be confused by contamination. Other conclusions of data examination are listed.

52567 (N–89-23547, pp. 587-588) **Working group written presentation: Atomic oxygen.** Leger, L.J.; Visentine, J.T. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. May 1989. (NASA-CP–3035-PT-2;L–16575-PT-2;NAS–1.55:3035-PT-2;CONF-8806434–: NASA/SDIO space environmental effects on materials workshop, Hampton, VA (USA), 28 Jun - 1 jul 1988). In *NASA/SDIO Space Environmental Effects on Materials Workshop, part 2.* Available from NTIS, PC A12/MF A01.

Earlier Shuttle flight experiments have shown NASA and SDIO spacecraft designed for operation in low-Earth orbit (LEO) must take into consideration the highly oxidative characteristics of the ambient flight environment. Materials most adversely affected by atomic oxygen interactions include organic films, advanced (carbon-based) composites, thermal control coatings, organic-based paints, optical coatings, and thermal control blankets commonly used in spacecraft applications. Earlier results of NASA flight experiments have shown prolonged exposure of sensitive spacecraft materials to the LEO environment will result in degraded systems performance or, more importantly, lead to requirements for excessive on-orbit maintenance, with both conditions contributing significantly to increased mission costs and reduced mission objectives. Flight data obtained from previous Space Shuttle missions and results of the Solar Max recovery mission are limited in terms of atomic oxygen exposure and accuracy of fluence estimates. The results of laboratory studies to investigate the long-term (15 to 30 yrs) effects of AO exposure on spacecraft surfaces are only recently available, and qualitative correlations of laboratory results with flight results have been obtained for only a limited number of materials. The working group recommended the most promising ground-based laboratories now under development be made operational as soon as possible to study the full-life effects of atomic oxygen exposure on spacecraft systems.

52568 (N–89-23547, pp. 607-608) **Working group written presentation: Solar radiation.** Slemp, W.S. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. May 1989. (NASA-CP–3035-PT-2;L–16575-PT-2;NAS–1.55:3035-PT-2;CONF-8806434–: NASA/SDIO space environmental effects on materials workshop, Hampton, VA (USA), 28 Jun - 1 jul 1988). In *NASA/SDIO Space Environmental Effects on Materials Workshop, part 2.* Available from NTIS, PC A12/MF A01.

The members of the Solar Radiation Working Group arrived at two major solar radiation technology needs: (1) generation of a long term flight data base; and (2) development of a standardized UV testing methodology. The flight data base should include 1 to 5 year exposure of optical filters, windows, thermal control coatings, hardened coatings, polymeric films, and structural composites. The UV flux and wavelength distribution, as well as particulate radiation flux and energy, should be measured during this flight exposure. A standard testing methodology is needed to establish techniques for highly accelerated UV exposure which will correlate well with flight test data. Currently, UV can only be accelerated to about 3 solar constants and can correlate well with flight exposure data. With space missions to 30 years, acceleration rates of 30 to 100X are needed for efficient laboratory testing.

52569 (NSS-R–136) **Long-term prediction of corrosion of stainless steel nuclear waste canisters.** Sharland, S.M.; Newton, C.J. United Kingdom Nirex, Ltd., Harwell (UK). Feb 1989. 16p. (CONF-881066–: 12. international symposium on the scientific basis for nuclear waste management, Berlin (Germany, F.R.), 10-13 Oct 1988; DOE-RW–89/007). Order Number DE90606347. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

In this paper, we describe the preliminary stages of the development of a mathematical model of the evolution of the solution chemistry within a corroding crevice on passive stainless steel. It is based on a formulation by Oldfield and Sutton (1), but models the physical and chemical processes which determine the crevice solution in a more rigorous manner. The model will eventually be used to assess whether a 'critical solution composition', which results in the depassivation of the crevice and the onset of localised corrosion, is attainable for a range of repository conditions, steel types and canister designs etc. We also describe experiments that provide input data in the form of passive currents for this model. Preliminary sensitivity tests with the model have indicated a need for accurate thermodynamic data for the chemical equilibria constants (particularly those for the chromium reactions). These tests also suggest that there are certain critical relationships between various parameters in the system (such as crevice dimensions, the composition of solution outside the crevice and the passive current) that mark different behaviour in the evolution of the solution composition. Further experiments are required both to validate the predictions of the model and to determine whether the predicted compositions of the crevice solutions are sufficiently aggressive to initiate crevice corrosion. (author).

52570 (ORNL/FTR–2611) **[Alloy phase stability]: Foreign trip report, June 11, 1987–June 29, 1987.** Stocks, G.M. Oak Ridge National Lab., TN (USA). 1 Jul 1987. 19p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89017283. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

I was co-director and organizer of a NATO Advanced Study Institute (ASI) on "Alloy Phase Stability" held in Crete. The school featured lectures by fifteen internationally recognized experts in the field. The lectures covered alloy design, thermodynamics, experimental solid state physics, statistical mechanics, and semiphenomenological and ab initio theory. The ASI had 83 invited participants selected from the NATO countries, Japan, and Brazil. The proceedings of the conference will be published as a collection of lecture notes by Martinus Nijhoff (Dordrect, The Netherlands).

52571 (ORNL/FTR–2650) **[Creep cavitation in nickel aluminides]: Foreign trip report, August 9, 1987–August 16, 1987.** Schneibel, J.H. Oak Ridge National Lab., TN (USA). 18 Aug 1987. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89017305. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Work on creep cavitation has been performed in collaboration with Professor L. Martinez of the Instituto de Fisica of the Universidad Nacional de Mexico in Cuernavaca, Mexico. A joint manuscript on "Influencing the Shape of Creep Cavities in Nickel Aluminides by Stress Changes" has been finalized. All details required to perform urgently needed numerical calculations on the growth of creep cavities in the presence of creep deformation have been identified and clearly defined. Ideas for incorporating the stochastic aspects of creep cavitation (coalescence) have been developed and will improve our present understanding of creep cavitation in nickel aluminides.

52572 (ORNL/FTR–2800) **[Fundamentals of materials processing]: Foreign trip report, December 30, 1987–January 31, 1988.** David, S.A. Oak Ridge National Lab., TN (USA). 2 Feb 1988. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89017300. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler attended the Indo-US Workshop on Fundamentals of Materials Processing and presented an invited paper entitled "Microstructural Modifications During Laser Welding." The workshop was organized by the US Office of Naval Research in collaboration with the Department of Science and Technology, India. The traveler was part of the US delegation comprised of world-renowned scientists representing the US Navy, National Science Foundation, National Bureau of Standards, and US universities. The Workshop

program continued several papers on topics relating to mathematical modeling of melting and solidification processes, continuous casting, laser, and plasma processing of materials. The traveler also attended a one-day Indo-US Workshop on Welding Science. Funds for the travel were provided by the US Navy through the Special Foreign Currency Program.

52573 (ORNL/M–939) **BES welding science contractors summary report, 1988–89.** David, S.A. (comp.). Oak Ridge National Lab., TN (USA). 1989. 35p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90001004. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report reviews the progress made in welding science by ORNL, Penn State University, MIT, Colorado School of Mines, and the University of California. ORNL is investigating the physical metallurgy of weldments and to develop the capability to predict weld metal microstructure and properties. Mass transfer during laser welding is being studied by Penn State University. MIT is studying the modelling of transport phenomena in weldpools. The role of composition and microstructure gradients on weld metal properties and behavior is covered by the Colorado School of Mines. The University of California has worked with the welding of 2090 Al-Cu-Li Alloy for cryogenic use. (JDL)

52574 (PB–89-201370/XAB) **Separation and recovery of metals from zinc-treated superalloy scrap. Report of investigations/ 1989.** Laverty, P.D.; Atkinson, G.B.; Desmond, D.P. Bureau of Mines, Reno, NV (USA). Reno Research Center. 1989. 23p. (BUMINES-RI–9235). Available from NTIS, PC A03/MF A01.

Library of Congress catalog card No. 88-600337.

The U.S. Bureau of Mines treated mixed and contaminated superalloy scrap by pyrometallurgical and hydrometallurgical methods to separate and recover metal values. Best results were obtained by leaching Zn-treated or atomized scrap with HC1-02 at 95 C and 50 psig O_2. This resulted in dissolving approximately 98% of the Al, Co, Cr, Cu, Fe, Mn, Ni, and Zn while rejecting over 98% of the Mo, Nb, Ta, Ti, W, and Zr as an insoluble refractory residue. Chlorine was successfully substituted for HC1 to leach Zn-treated scrap but unsuccessful for leaching atomized scrap. The leaching solution was treated by pH adjustment and hydrothermal precipitation at 200 C for 4 h to remove Al, Cr, Fe, and other contaminants as a filterable precipitate. Recovery of Co and Ni would be accomplished by solvent extraction and electrowinning. Chromium recovery as a ferroally was demonstrated.

52575 (PB–89-867873/XAB) **Heat exchangers: Biofouling. January 1974-July 1989 (Citations from the COMPENDEX database). Report for January 1974-July 1989.** National Technical Information Service, Springfield, VA (USA). Aug 1989. 48p. Available from NTISPC N01/MF N01.

Supersedes PB–87-857389.

This bibliography contains citations concerning biological fouling and associated corrosion of heat exchangers and cooling systems. Topics include chlorination methods and systems, biocides, microbiological corrosion control, and alternative controls that comply with environmental regulations. Applications in cooling towers, ocean thermal energy conversion, nuclear power plants, and conventional oil and coal-fired power plants are considered. Antifouling coatings for marine applications are discussed in separate bibliographies. (This updated bibliography contains 91 citations, 12 of which are new entries to the previous edition.)

52576 (SAND–89-1322C) **Surface roughening of Ge(001) during 200 eV Xe ion bombardment and Ge molecular beam epitaxy.** Chason, E.; Tsao, J.Y.; Horn, K.M.; Picraux, S.T.; Atwater, H.A. Sandia National Labs., Albuquerque, NM (USA). 1989. 19p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-891093–6: 36. American Vacuum Society national vacuum symposium, Boston, MA (USA), 23-27 Oct 1989). Order Number DE90000674. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The kinetics of surface roughening of Ge (001) during 200 eV Xe ion bombardment and during Ge molecular beam epitaxy are studied by real- time reflection high-energy electron diffraction. In both cases, initially smooth surfaces reach a steady state roughness which depends on temperature and incident ion or adatom flux. The data are analyzed in terms of a model in which defect-induced roughening competes with defect-induced smoothening, and in which the defect creation rate and surface diffusivity are fitting parameters. For comparable fluxes, the temperature dependences for the net roughening induced by ions and adatoms are strikingly similar, implying a similarity in the surface diffusivities of vacancies and adatoms. For the case of ion-induced roughening, a defect creation rate of 3 per ion is obtained which is consistent with calculations and which indicates that the majority of atomic displacements produce surface defects at these ion energies. 11 refs., 3 figs.

52577 (SAND–89-1571) **Projectile Impact Hugoniot parameters for selected materials.** Vigil, M.G. Sandia National Labs., Albuquerque, NM (USA). Aug 1989. 58p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE90000891. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The Rankine Hugoniot equation relating the conversion of momentum across a shock front and the empirical relationship for shock velocity as a function of particle velocity are used to calculate the impact pressures for selected materials. The shock velocity and particle velocities are then calculated as a function of impact pressures. The calculated data are graphically presented sets of three figures for the selected materials as follows: Impact pressure as a function of impact velocity, impact pressure as a function of particle velocity, impact pressure as a function of shock velocity. Given the projectile impact velocity and material Hugoniot information, this graphical representation of the data allows for a fast approximation of the impact pressure particle velocity, and shock velocity in the target material. 9 refs., 1 fig., 3 tabs.

52578 (UCRL–100796) **Analysis of nitrogen-pulsed sputtered beryllium.** Price, C.W.; Norberg, J.C. Lawrence Livermore National Lab., CA (USA). 27 Jul 1989. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8909172–2: SIMS VII: 7th international conference on secondary ion mass spectrometry, Monterey, CA (USA), 3-8 Sep 1989). Order Number DE90001683. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Mirror-quality beryllium films deposited by DC magnetron sputtering usually from columnar grain structures that are highly detrimental to the properties of the films. These columnar structures can be modified by imposing periodic pulses of nitrogen gas during sputtering. This paper describes ion microanalyses of beryllium films produced by this technique. 5 refs., 2 figs.

52579 (WHC-EP–0254) **Corrosion of candidate container materials.** Brehm, W.F. Westinghouse Hanford Co., Richland, WA (USA). Sep 1989. 21p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-87RL10930. Order Number DE90001255. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Ferrous and copper-base alloys were tested in various saturated packing and air-steam environments relevant to those that would be experienced by container materials in a nuclear waste repository in basalt. Corrosion rates of materials were small in the relatively benign environment, with few exceptions. An investigation was made regarding the cause of considerable data scatter that was observed only with copper-base alloys in saturated packing. An increased corrosion rate under gamma irradiation was observed only in the air-steam environment on both ferrous and copper-base materials at high temperature. The increase in corrosion rate was not satisfactorily explained by conventional theories regarding irradiation-assisted corrosion.

52580 **Crevice corrosion of some stainless steels in surface and deep ocean waters.** Larsen-Basse, J.; Htun, K.M.; Nuti, P. 14p. National Assoc. of Corrosion Engineers, Houston, TX (1988). (CONF-880314–: Corrosion '88: National Association of Corrosion Engineers meeting, St. Louis, MO (USA), 21-25 Mar 1988).

Technical Paper 88406.

Parallel crevice corrosion tests were conducted in pumped prototypical OTEC seawaters - warm surface seawater and cold deep ocean water. Multiple crevice assemblies were used. The results are generally consistent with results from other test sites, except for some minor variations. It was found that the cold deep-ocean water

is somewhat less aggressive than the surface water but it is possible that this difference may disappear over very long periods of exposures. For the high alloy stainless steels, the incubation period for crevice corrosion may be well in excess of sixty days. Full immunity was shown by the ferritic alloy 29-4C, the austenitic JS 700 and the Ni-base alloy Hastelloy 276. Minor attack was shown by 256 SMo, AL-6XN, JS 777, and Hastelloy G3. AL-6X was immune in the cold water but showed significant corrosion in the warm while the opposite was true for a number of aluminum alloys. Nitronic 50 and alloys 316 and 304 corroded rapidly in both waters.

52581 **Response of aluminum alloys to erosive particle impacts.** Keiser, J.R.; Heidersbach, R.S.; Dobbs, D.L.; Oliver, W.C. 11p. National Assoc. of Corrosion Engineers, Houston, TX (1988). (CONF-880314--: Corrosion '88: National Association of Corrosion Engineers meeting, St. Louis, MO (USA), 21-25 Mar 1988).

Technical Paper 88146.

Erosive particle impacts can result in the high-strain-rate deposition of an appreciable amount of energy into the deformed volume of the target material. This energy likely causes local heating; softening or even melting has been observed in many materials. Hardening caused by the high-strain-rate deformation has also been reported for strain-hardenable materials. The effect of individual impacts on the surface of selected aluminum alloys was determined both analytically using theoretical considerations and experimentally using 343-μm-diam tungsten carbide balls impacting at about 30 m/s and 30^0 incidence angle. After impact a mechanical properties microprobe was used to measure the hardness of both the crater bottom and material just below the original surface. Strain hardening, but no evidence of softening, was observed for two aluminum alloys.

52582 **The effect of test conditions on the erosion-corrosion of alternate low alloy steel tubing alloys.** Levy, A.V.; Wang, B.Q. 17p. National Assoc. of Corrosion Engineers, Houston, TX (1988). (CONF-880314--: Corrosion '88: National Association of Corrosion Engineers meeting, St. Louis, MO (USA), 21-25 Mar 1988).

Technical Paper 88147.

A group of low chromium content tubing steels with additional amounts of silicon were erosion-corrosion tested in air at temperatures to 850^0C with angular shaped erodent particles and FBC bed material. In previous tests using round shape erodent particles, these modified steels formed highly segmented scales which resulted in considerably lower erosion-corrosion metal wastage rates than occurred in typical silicon content low chromium steels. The same type of behavior occurred when angular shaped particles were used but to a lesser extent. The angular shaped particles resulted in thin scales that directly involved the substrate metal in the metal wastage process.

52583 **Elastic properties of superlattices.** Grimsditch, M. (Argonne Nat. Lab., Argonne, IL). pp. 811 of Interfaces, superlattices, and thin films. Dow, J.D.; Schuller, I.K Materials Research Society, Pittsburgh, PA (1987). (CONF-8612131--: Materials Research Society symposium on interfaces, superlattices and thin films, Boston, MA (USA), 1-6 Dec 1986).

A calculation of the effective elastic moduli of a superlattice, in terms of the elastic moduli of its constituents, is presented. Contrary to what has been found in many real systems, these calculations show that in the long wavelength limit the effective elastic moduli are independent of the modulation wavelength. A discussion of the experimental results on Nb/Cu, Mo/Ni and Au/Cr shows that the elastic anomalies can be understood on the basis of concomitant changes in lattice spacings.

52584 **Characterization techniques for ion bombarded insulators.** Borders, J.A. pp. 648 of Ion beam modification of insulators: Volume 2. Mazzoldi, P.; Arnold, G.W. Elsevier Science Pub. Co. Inc., New York, NY (1987).

This chapter reviews characterization techniques that are commonly used for ion bombarded insulators. Most ion implantation research has been carried out on metal or semiconductor targets with much less attention being paid to implanted insulators and thus most of the characterization methods that have been developed have been applied primarily to metals and semiconductors. Some of these methods are also useful for ion bombarded insulators, but here may be techniques useful for metals and semiconductors which are not discussed here because they are not particularly applicable to insulators. In general, only widely used analytical methods are reviewed. There are certainly methods that are useful for particular applications, but if those techniques are not widely available or are useful only for very specialized research applications, they are probably not included in this chapter. Many of the examples presented in this chapter are taken from the Proceeding of the Radiation Effects in Insulators Conferences which are excellent sources of information on the various types of studies taking place in the field of ion bombarded insulators.

52585 **X-ray-optical multilayer structures studied using high resolution electron microscopy.** Stearns, M.B. (Lawrence Livermore Nat. Lab., Livermore, CA); Petford-Long, A.K.; Chang, C.H.; Stearns, D.G.; Ceglio, N.M.; Hawryluk, A.M. pp. 811 of Interfaces, superlattices, and thin films. Dow, J.D.; Schuller, I.K Materials Research Society, Pittsburgh, PA (1987). (CONF-8612131--: Materials Research Society symposium on interfaces, superlattices and thin films, Boston, MA (USA), 1-6 Dec 1986).

The technique of high resolution electron microscopy has been used to examine the structure of several multilayer systems (MLS) on an atomic scale. Mo/Si multilayers, of interest because of their magnetic properties, have been imaged in cross-section. Layer thicknesses, flatness and smoothness have been analyzed: the layer width can vary by up to 0.6 nm from the average value, and the layer flatness depends on the quality of the substrate surface for amorphous MLS, and on the details of the crystalline growth for the crystalline materials. The degree of crystallinity and the crystal orientation within the layers have also been investigated. In both cases, the high-Z layers are predominantly crystalline and the Si layers appear amorphous. Amorphous interfacial regions are visible between the Mo and Si layers, and crystalline cobalt silicide interfacial regions between the Co and Si layers. Using the structural measurements obtained from the HREM results, theoretical x-ray reflectivity behaviour has been calculated. It fits the experimental data very well.

52586 **Experimental evidence for nucleation during thin-film reactions.** Coffey, K.R. (Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139 (US)); Clevenger, L.A.; Barmak, K.; Rudman, D.A.; Thompson, C.V. *Applied Physics Letters (USA)*, 55(9): 852-854 (28 Aug 1989).

The reaction between solid layers to form a product phase has been studied using scanning calorimetry of multilayer Nb/Al and Ni/amorphous-Si thin films. The most striking feature for both materials systems is the occurrence of two maxima in the reaction rate during the formation of a single product phase, suggesting a two step growth process. A model has been developed in which the first step is taken to be the nucleation and two-dimensional growth to coalescence of the product phase, in the plane of the initial interface. The second step is taken to be the thickening of the product layer by growth perpendicular to the interface plane. The success of this simple model in describing the principal features of the experimental results on two different materials systems suggests that nucleation is an important aspect of phase formation and selection in these thin-film reactions.

52587 **Texture and textural evolution in explosively formed jets.** Schiferl, S.K. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545 (US)). *Journal of Applied Physics (USA)*, 66(6): 2637-2650 (15 Sep 1989).

The potential effects of crystallographic texture (preferred grain orientation) on the behavior of metallic shaped-charge jets are examined. There is some experimental evidence that strong initial liner textures can be beneficial to overall performance; in this paper we investigate the mode of action of such textures. A crystallographic-texture code was used to calculate the changes in preferred orientation, and the corresponding changes in yield anisotropies, for deformation paths typical of early jet formation. Simulations were performed for two different initial textures, and for two different regions in a hemispherical titanium liner. It was found that the initial texture and its corresponding pattern of anisotropy do not persist beyond the earliest stages of liner collapse; the state of the material in a well-formed solid jet reflects the most recent deformation, not

the initial texture. Any initial texture effect on subsequent jet behavior would be exerted indirectly, e.g., through changes in flow patterns induced during the first few microseconds of deformation. During this time, the evolution of texture and the corresponding anisotropies were found to be significantly different, not only for different initial textures, but also for different regions of the liner. This is due to the variation in deformation paths, and, in our model for titanium, to differences in the relative importance of slip and twinning.

52588 Amorphization of stainless steels by carbon implantation. Follstaedt, D.M. (Sandia National Laboratories, Albuquerque, New Mexico 87185-5800 (US)); Knapp, J.A.; Pope, L.E. *Journal of Applied Physics (USA),* 66(6): 2743-2746 (15 Sep 1989). DOE Contract AC04-76DP00789.

The ion implantation of C has been discovered to amorphize stainless steels, in contrast to the formation of crystalline carbides for pure Fe. Examination of C-implanted Fe(Cr) alloys indicates that the amorphous phase is stabilized by 12–18 at. % Cr in the steels. Reduced friction is found for C-implanted stainless steels, but an amorphous layer with C alone is more easily worn away than one with both Ti and C. This and other comparisons indicate that both Ti and C are essential for the extended wear resistance and low friction of amorphous Fe(Ti,C) surface alloys.

52589 Full-potential linear augmented–Slater-type-orbital method. Fernando, G.W. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973-6000 (US)); Davenport, J.W.; Watson, R.E.; Weinert, M. *Physical Review [Section] B: Condensed Matter (USA),* 40(5): 2757-2766 (15 Aug 1989). DOE Contract AC02-76CH00016.

We have incorporated the full potential into the linear augmented–Slater-type-orbital method. Here we report on the details of the calculations and also specifically on the nature and the significance of the non-muffin-tin terms, some interesting structures of the potential and the charge density for standard test systems such as fcc Al, bcc W, fcc Pt, all of which have the O_h point-group symmetry. We have seen that for cubic systems, both the l=4 and l=6 components of the charge density and the potential in the sphere regions are important. We have also seen that this method with its inherently small basis set is capable of yielding total energies of comparable accuracy to the full-potential linear augmented-plane-wave method.

52590 Structures of [001] twist boundaries in gold. I. Measurement and use of absolute boundary x-ray structure factors. Taylor, M.S. (Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139 (US)); Majid, I.; Bristowe, P.D.; Balluffi, R.W. *Physical Review [Section] B: Condensed Matter (USA),* 40(5): 2772-2778 (15 Aug 1989).

An x-ray-diffraction method for measuring absolute grain-boundary structure factors is described. The method is based on ratioing appropriate integrated scattered intensities from the grain-boundary region and from the adjoining perfect-crystal region in a bicrystal specimen containing a flat grain boundary. Common unknown factors then cancel out, and an expression for the absolute structure factor is obtained in which all quantities are either known, can be measured, or can be calculated with acceptable accuracy. A practical experimental technique for making the necessary measurements, which employs a four-circle diffractometer, is described. The technique is applied to an x-ray diffraction study of the atomistic structures of a series of [001] twist boundaries in gold in the following paper of our work. The results obtained there clearly demonstrate that the measurement of absolute structure factors, rather than relative structure factors, provides important information in diffraction studies of the structures of grain boundaries, particularly in cases where a limited number of structure factors is measured.

52591 Structures of [001] twist boundaries in gold. II. Results obtained by x-ray diffraction and computer simulation. Majid, I. (Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139 (US)); Bristowe, P.D.; Balluffi, R.W. *Physical Review [Section] B: Condensed Matter (USA),* 40(5): 2779-2792 (15 Aug 1989).

Absolute grain-boundary structure factors, $|F_b|$, were measured for a series of [001] twist boundaries in gold by the x-ray-diffraction method described in the preceding paper. The series included the $\Sigma113(\theta=7.6°)$, $\Sigma25(\theta=16.3°)$, $\Sigma13(\theta=22.6°)$, $\Sigma17(\theta=28.1°)$, and $\Sigma5(\theta=36.9°)$ boundaries (θ being the twist angle). The atomistic structures and $|F_b|$'s of these boundaries were also calculated by computer simulation using the embedded-atom model. The calculated atomic relaxations in the boundary cores consisted mainly of rotations around the O lattice elements, in agreement with previous work, and became monotonically weaker as θ increased. A considerable degree of consistency between measured and calculated $|F_b|$'s was obtained for all five boundaries. The calculated results faithfully tracked large measured decreases in $|F_b|$ as θ increased. Considerable consistency was found between measured and calculated sets of $|F_b|$'s for individual boundaries, particularly for $\Sigma113$ and $\Sigma25$, where the scattering was relatively strong. For the weakly scattering $\Sigma5$ boundary, the observed $|F_b|$'s led to a most probable structure with small displacements which closely resembled the calculated structure. For the intermediate $\Sigma13$ and $\Sigma17$ boundaries, the limited number of measured $|F_b|$'s was reasonably consistent with calculated values. It was therefore concluded that the atomistic boundary structures calculated by the embedded-atom model were essentially correct.

52592 Molecular-dynamics study of lattice-defect-nucleated melting in metals using an embedded-atom-method potential. Lutsko, J.F. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439 (US)); Wolf, D.; Phillpot, S.R.; Yip, S. *Physical Review [Section] B: Condensed Matter (USA),* 40(5): 2841-2855 (15 Aug 1989). DOE Contract W-31-109-ENG-38.

The high-temperature behavior of a high-angle twist grain boundary, a free surface, and planar arrays of voids of various sizes, all on the (001) plane in copper, are studied through molecular-dynamics simulation using an embedded-atom-method potential. Independently, we determine the thermodynamic melting point, T_m of this potential through an analysis of the free energies of a perfect crystal and the liquid phase. It is found that an ideal crystal consisting of nearly 1000 atoms may be superheated over 200 K above T_m while the introduction of any of the defects listed above nucleates melting at any temperature above T_m. We conclude that nucleation of the liquid phase at extrinsic defects is the most rapid, and therefore the dominant, mechanism of melting.

52593 Bulk and surface vibrational modes in NiAl. Mostoller, M. (Solid State Division, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, Tennessee 37831-6032 (US)); Nicklow, R.M.; Zehner, D.M.; Lui, S.; Mundenar, J.M.; Plummer, E.W. *Physical Review [Section] B: Condensed Matter (USA),* 40(5): 2856-2872 (15 Aug 1989). DOE Contract AC05-84OR21400.

We have measured the phonon dispersion curves of bulk NiAl along the three major symmetry directions by neutron scattering, and fitted the results with force models extending to third- and fourth-nearest neighbors. Our electron-energy-loss experiments show that dipole-active vibrational modes occur in the gap between the bulk acoustical and optical modes for the (110) and (111) surfaces. We have done extensive slab calculations of the vibrational modes at the surface-Brillouin-zone center for these two faces and for NiAl(001). The calculations indicate that the atomic motion for the gap modes is correlated with the bulk properties. Adjustment of the interplanar force constants in directions intuitively consistent with experimental results for the surface relaxations can shift the calculated frequencies into agreement with experiment.

52594 Molecular cluster model for magnetic iron. Pavao, A.C. (Departamento de Quiiaamica Fundamental, Universidade Federal de Pernambuco, 50.739 Recife, Pernambuco, Brazil (BR)); Taft, C.A.; Hammond, B.L.; Lester, W.A. Jr. *Physical Review [Section] B: Condensed Matter (USA),* 40(5): 2879-2884 (15 Aug 1989).

Ab initio Hartree-Fock calculations were performed on the quintet spin state of the Fe_2 molecule in order to study the electronic, magnetic, and chemical bonding properties as well as the hyperfine interactions. Good agreement is found with band-theoretical and experimental parameters. The calculations support Pauling's model of occupation and bonding of valence orbitals, resonance of covalent bonds, and conduction-band metallic orbitals. A strong charge-polarization effect is found that is not observed in the septet ground state. The participation of s and d electrons in bonding is similar to that found in recent configuration-interaction (CI) calculations on the

ground state. The calculated magneton number is in good agreement with experiment.

52595 Eddy current shielding and heating: Reduction of dissipation for very low-temperature experiments in the presence of magnetic field ripple. Meyer, E.S. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138 (US)); Silvera, I.F.; Brandt, B.L. *Review of Scientific Instruments (USA),* 60(9): 2964-2968 (Sep 1989).

We have studied eddy current heating and shielding for conducting materials in a cylindrical geometry, and we have performed numerical calculations as a function of the important parameters. Results are presented in graphical form. Eddy current heating in OFHC copper at low temperatures and means of suppressing it have been studied in a Bitter magnet in a field of 15 T. Results show that it is possible to use conducting materials for experiments in high magnetic fields at temperatures below 1 K.

52596 Remarkably diverse interstitial chemistry of the polar intermetallic phase Zr_5Sb_3. Garcia, E. (Iowa State Univ., Ames (USA)); Corbett, J.D. *Inorganic Chemistry (USA),* 27(17): 2907-2908 (24 Aug 1988).

The preparation of single-phase interstitial compounds of Zr_5Sb_3 with C, O, Fe, Co, Ni, Cu, Al, Si, P, S, Zn, Ga, Ge, As, Si, Ru, Ag, and Sb is described. Single-crystal x-ray studies are reported for some of the compounds. It is concluded that (1) the Zr_5Sb_3 is a strongly bonded host dominated by Zr-Sb bonding with 11 electrons in the conduction band, (2) the addition of an interstitial Z to the chain produces strong Z-Z bonding with the loss of only moderate Zr-Zr bonding in the empty chain and with little perturbation of the Zr-Sb host, and (3) electrons and zirconium 4d orbitals necessary to bind Z are readily available in the conduction bond states. 10 references, 2 figures.

52597 Thermochemistry of the gadolinium-copper interface. LaGraffe, D. (Department of Physics, Syracuse University, Syracuse, New York 13244-1130 (US)); Dowben, P.A.; Onellion, M. *Physical Review [Section] B: Condensed Matter (USA),* 40(5): 3348-3351 (15 Aug 1989).

We have characterized the thermochemistry of the gadolinium-copper interface using valence-band photoemission. We find that the copper substrate binds strongly with the gadolinium overlayer, based upon valence-band binding-energy shifts that occur with increasing gadolinium coverages on Cu(100). The net potential for copper at the interface is 3.82 eV/atom which is some 0.51 eV/atom greater than the heat of sublimation for copper. The strong bonds formed between copper and gadolinium provide a thermochemical driving force for copper gadolinium-alloy formation. We observed a surface-to-bulk core-level shift for gadolinium of 0.3–0.4 eV. We also observed a Cu 3*d* binding-energy increase of 0.73 eV with increasing coverage.

52598 Electronic structure near (210) tilt boundaries in nickel. Crampin, S. (The Blackett Laboratory, Imperial College, London SW72BZ, United Kingdom (GB)); Vvedensky, D.D.; MacLaren, J.M.; Eberhart, M.E. *Physical Review [Section] B: Condensed Matter (USA),* 40(5): 3413-3416 (15 Aug 1989).

We report the first self-consistent electronic structure calculations of an isolated Σ5 tilt boundary in a transition metal, including the effects of segregants that induce intergranular brittleness. The local densities of states near the grain boundary show narrowed *d* bands due to reduced coordination, with the full band width restored within three layers. The presence of S segregants at the grain boundary inhibits Ni bonding across the interface, though the effect of the impurities is effectively screened within three layers.

52599 Resonant enhancement of inverse photoemission transitions in bulk niobium. Pan, X. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973 (US)); Viescas, A.J.; Johnson, P.D. *Physical Review [Section] B: Condensed Matter (USA),* 40(5): 3425-3428 (15 Aug 1989). DOE Contract AC02-76CH00016.

We report the observation of the resonant enhancement of inverse photoemission transitions involving bulk band states of niobium when the energy of the transition corresponds to the plasma frequency. On resonance the cross-section increases by a factor of ~5. Comparison with earlier reflectivity data confirms that the resonance occurs at the plasma frequency but the mearsured plasmon energy of 19.3 eV is slightly less than the 20.8 eV found in the earlier study. We do not observe resonant enhancement of transitions into surface states or interface states.

52600 Surface and thin-film photoemission spectrum of nickel metal: A many-body solution to a two-dimensionally periodic cluster. Chen, C. (Department of Physics, University of California, Berkeley, California 94720 (US)); Falicov, L.M. *Physical Review [Section] B: Condensed Matter (USA),* 40(6): 3560-3569 (15 Aug 1989). DOE Contract AC03-76SF00098.

An exact solution of a four-site crystal model with periodic boundary conditions, a {001} thin film with face-centered-cubic crystal structure, is presented for the nickel density of electron states, as would be measured in surface-sensitive valence-band photoemission. The object is to study modifications of the many-body electronic structure in the presence of surfaces. The model consists of (a) five *d* orbitals per site per spin, with nearest-neighbor hopping, (b) a one-electron occupation energy for each orbital, and (c) Coulomb repulsions between electrons on the same site. A realistic local-density-approximation one-electron structure and intrasite electron-electron interactions most generally allowed by atomic symmetry are used. Crystal-field effects and single-particle electronic structure in the nickel-film structure are discussed. The photoemission spectrum is calculated and compared with bulk results. Physical conclusions for the true nickel surface many-body states are drawn.

52601 Quasiparticle energies in small metal clusters. Saito, S. (Department of Physics, University of California, Berkeley, California 94720 (US)); Zhang, S.B.; Louie, S.G.; Cohen, M.L. *Physical Review [Section] B: Condensed Matter (USA),* 40(6): 3643-3646 (15 Aug 1989). DOE Contract AC03-76SF00098.

We have calculated the quasiparticle energies of sodium and potassium clusters using the jellium-sphere-background model for positive-ion cores and the Hedin *GW* approximation for the self-energies of valence electrons. In the calculation of the screened Coulomb interaction, a new general method to approximate the excitation spectrum of the interacting many-body systems is introduced. The calculated ionization potentials and quasiparticle energies are significantly improved compared to calculations based on the Hohenberg-Kohn-Sham local-density-functional theory.

52602 Brillouin scattering from corrugated Ag films: Surface-plasmon-mediated enhancement and relaxed wave-vector conservation. Robertson, W.M. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439-4843 (US)); Grimsditch, M.; Moretti, A.L.; Kaufman, R.G.; Hulse, G.R.; Fullerton, E.; Schuller, I.K. *Physical Review [Section] B: Condensed Matter (USA),* 40(6): 4153-4156 (15 Aug 1989). DOE Contract FG03-87ER45332.

We report the investigation of Brillouin scattering from thermal surface acoustic waves on Ag-coated holographic gratings. The usual wave-vector conservation condition for Brillouin scattering is modified due to the added periodicity in the direction of phonon propagation, but this effect is observed only when surface plasmons act as an intermediate state in the scattering process. The involvement of surface plasmons results in an enhancement of the Brillouin scattering cross section which depends on the grating amplitude.

52603 Topologies and relative energies of stacking faults occurring in the close-packed phases of Li. Gooding, R.J. (Laboratory of Atomic and Solid State Physics, Cornell University, Ithaca, New York 14853-2501 (US)). *Physical Review [Section] B: Condensed Matter (USA),* 40(6): 4157-4159 (15 Aug 1989).

We utilize a continuum Ginzburg-Landau theory to predict both the homogeneous and inhomogeneous structures that can result in bcc-to-9*R* and bcc-to-fcc martensitic structural phase transformations. The simple proposition is made that the stacking faults that occur during the transitions to these structures are low-energy (static) structural excitations of the displacement pattern connecting parent and product phases. Then, a discussion of the topologies of the stacking faults, and their relative energies, predicted to occur in 9*R* and fcc Li are shown to be in agreement with the observed shifts of the Bragg peaks of the product phases from their ideal positions.

3602 Ceramics, Cermets, and Refractories

Refer also to citation(s) 51959, 52118, 52139, 52146, 52147, 52476, 52538, 52545, 52596, 52638, 52645, 52897, 52946, 53029, 53900, 53906, 53916

52604 (AD-A–208980/3/XAB) **Electrochemical formation of polypyrrole films on $YBa_2Cu_3O_{7-x}$. Technical report.** Osteryoung, J.G.; Magee, L.J.; Carlin, R.T. State Univ. of New York, Buffalo, NY (USA). Dept. of Chemistry. Oct 1988. 6p. (TR–20). Available from NTIS, PC A02/MF A01.

Pub. in Jnl. of the Electrochemical Society, Vol. 135, No. 10, 2654-2655(Oct 1988). Errata sheet inserted.

Aqueous electrochemical processes at the surface of the high-temperature superconductor $YBa_2Cu_3O_{7-x}$, including deposition of silver and magnesium, have been reported. This superconductor dissolves spontaneously under acidic conditions, and barium dissolves and oxide films form during anodization in neutral and basic electrolytes. An additional complication for electrodeposition of metals onto $YBa_2Cu_3O_{7-x}$ is the competing reduction of the substrate. We report here the electrodeposition of polypyrrole from acetonitrile (MeCN) onto $YBa_2Cu_3O_{7-x}$. Since polypyrrole is formed by oxidation of pyrrole, the substrate is not reduced at the potentials employed. For comparison, deposition of AG from MeCN is also discussed.

52605 (AD-A–209191/6/XAB) **High-temperature superconductivity research in selected laboratories in West Germany. Technical report.** Liebenberg, D.H.; Clark, A. Office of Naval Research (USA). London Branch Office. 8 Jul 1988. 10p. (ONR–8-011-R). Available from NTIS, PC A02/MF A01.

SUPERCONDUCTIVITY/research programs; CUPRATES/superconductivity; SUPERCONDUCTIVITY; SUPERCONDUCTORS; TRANSITION TEMPERATURE; YTTRIUM COMPOUNDS; BARIUM COMPOUNDS; COPPER COMPOUNDS; CUPRATES; PROGRESS REPORT

52606 (AD-A–209302/9/XAB) **Nitrogen ceramics meeting in France.** Cartz, L. Office of Naval Research (USA). London Branch Office. 21 Jan 1988. 6p. (ONRL–8-004-C). Available from NTIS, PC A02/MF A01.

Presentations given at this meeting–JENI7–held in Rennes, France, in September 1987, are briefly reported. A very wide range of nitrogen ceramics properties was discussed at the meeting, in particular, their chemistry, crystallography, and sintering behavior. Contents of this paper include: Nitrogen pyroxenes; Precursors of SiC and Si_3N_4; A pure form of A1N; The Ti-N system; Nitrogen glasses; Zn and Ge oxynitrides; Zr_3A1N and Hf_3AN.

52607 (AD-A–209315/1/XAB) **Observation of a far-infrared sphere resonance in superconducting La(2-x)Sr(x)CuO(4-y) particles.** Sievers, A.J. Cornell Univ., Ithaca, NY (USA). 30 Jan 1989. 5p. Available from NTIS, PC A02/MF A01.

Pub. in Physical Review Letters, Vol. 62, No. 5, 599-602(30 Jan 1989).

Far-infrared (FIR) spectroscopic data on high-Tc single crystals in the superconducting state have been interpreted as evidence for a large energy gap, a BCS-type gap, or no gap at all. The optical properties of crystals of variable quality make it difficult to conclude whether or not the peak observed in the ratio of the FIR reflectivity of the a-b plane of $YBa_2CuO(7-y)$ in the superconducting state to that of the normal state should be interpreted as evidence for the energy gap or as evidence for a zero crossing of the real part of the dielectric function. The gap of La(2-x)Sr(x)CuO(4-y) is even less well determined because it has been difficult to grow single crystals at the Sr doping which produces the highest Tc's. The optical properties of superconducting sintered La(2-x)Sr(x)CuO(4-y) were analyzed in some detail but the excess absorption in the superconducting state associated with transport between grains obscures the determination of a true gap signature.

52608 (AD-A–209376/3/XAB) **Crystal chemistry, magnetic and electrical properties of $La(2-x)BaxNiO_4$.** Austin, A.B. Army Materials Research Agency, Watertown, MA (USA). Materials Technology Lab. Feb 1989. 83p. (MTL-TR–89-10). Available from NTIS, PC A05/MF A01.

The series of compositions $La_{2-x}BaXNiO_4$ ($0 < or = x < or = 1.0$) was prepared by standard ceramic techniques. All members of the system crystalized with the tetragonal K_2NiF_4 structure. The ratio of lattice parameters, c/a, reached a maximum in the range x = 0.5 to 0.6; c increased up to this point while a decreased, and this trend reversed after the maximum was reached. Increase in c/a is attributed to a weak Jahn-Teller distortion due to octahedral site low-spin Ni(3+) ions. Magnetic susceptibilities measured in the temperature range 6 to 300 K and room temperature resistivity measurements showed that with addition of any barium into the system, a significant change was seen in both magnetic and electrical properties. An anomaly in the magnetic susceptibility was seen at 110 K in La_2NiO_4. This anomaly disappeared and magnetic susceptibility dropped by a factor of at least one-third with addition of barium. With further increases in barium, the susceptibility value did not differ significantly in all Ba-substituted compounds. Room-temperature resistivity dropped from 0.14 ohm-cm for La_2NiO_4 to 0.05 ohm-cm for $La(1.8)Ba(.2)NiO_4$ and decreased only slightly thereafter with increasing barium. Semiconducting behavior was observed for all the compounds. Oxygen stoichiometry is suspected to play a critical role in explaining these behaviors.

52609 (BNL–42928) **X-ray reflectivity study of SiO_2 on Si.** Heald, S.M.; Jayanetti, J.K.D.; Bright, A.A.; Rubloff, G.W. Brookhaven National Lab., Upton, NY (USA). 1989. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016;AS05-80ER10742. (CONF-891093–4: 36. American Vacuum Society national vacuum symposium, Boston, MA (USA), 23-27 Oct 1989). Order Number DE90001326. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

X-ray reflectivity is a powerful probe of thin film morphology. It can be used to non-destructively determine the interface and surface roughness, thickness and density of the layers. This paper presents the application of the technique to the case of SiO_2 on Si. Experimental reflectivity results with a dynamic range of 10^6 have been obtained on a number of oxide layers prepared using processing conditions. The reflectivity oscillations caused by oxide layers could be easily observed over this entire range, and significant differences were observed between samples. In particular, a PECVD grown oxide is found to have an interfacial layer of lower density. 12 refs., 3 figs., 1 tab.

52610 (BNL–43312) **Flux pinning and microstructure in $YBa_2Cu_3O_7$.** Suenaga, M.; Welch, D.O.; Xu, Youwen; Zhu, Y.; Ghosh, A.K.; Moodenbaugh, A.R. Brookhaven National Lab., Upton, NY (USA). 1989. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890981–2: Windpower '89, San Francisco, CA (USA), 24-27 Sep 1989). Order Number DE90001562. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Critical current densities J_c of superconductors are one of the most important properties of superconductors in the majority of applications. Unfortunately, in spite of the fact that tremendous efforts have been mounted internationally in studies of the high temperature oxide superconductors, the current values of J_c are disappointingly low except in single crystal bulk specimens and films with the current flowing in the basal planes. When 2% of the Cu in $YBa_2Cu_3O_7$ is replaces by either Al or Fe, it is found that the intragranular critical current densities of these alloyed oxides were reduced. On the other hand, it was also found that substitution for Cu by 2% Ni did not show any effect on J_c at 10 K. In order to illustrate what are the primary controlling parameters in reducing the values of J_c when small amounts of Cu were replaced by Fe or Al, we will first review some elementary aspects of flux pinning mechanisms. Then it will be shown how those parameters which are pertinent to flux pinning may be estimated for these specimens. Finally, we will deduce what is probably the most prominent cause for the reduction in J_c for the specimens discussed above. 43 refs., 8 figs.

52611 (CONF-890939–1) **Static and dynamic magnetization properties of $Y_1Ba_2Cu_3O_z$ thin films.** Sekula, S.T. Oak Ridge National Lab., TN (USA). Aug 1989. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From International conference on high T_c thin films and single crystals; Ustron (Poland); 30 Sep - 4 oct 1989. Order Number DE89017584. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Magnetization studies were carried out on $Y_1Ba_2Cu_3O_z$ (YBCO) thin films that were e-beam evaporated onto circular discs of single-crystal $SrTiO_3$ with (001) and (110) faces as well as $KTaO_3$ with (001) faces. The measurements were made using vibrating sample (VSM) and SQUID-based magnetometry with the applied field perpendicular to the substrate surface. Critical current densities $J_c(H,T)$ are deduced from the magnetic hysteresis. Flux creep effects are observed over longer periods with the SQUID magnetometer. Analysis of the results of low frequency response of these films to collinear ac and dc magnetic fields are compared with the dc magnetometry results. $J_c(H,T)$ is observed to be quite sensitive to the type of epitaxial growth on the various substrates. 16 refs., 10 figs.

52612 (CONF-8907116–5) **SEM [scanning electron microscope] image analysis of grain growth in microwave-annealed alumina.** Schmidt, M.A.; Janney, M.A.; Mayotte, J.R. Oak Ridge National Lab., TN (USA). 1989. 27p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From 22. annual international Metallographic Society meeting; Charlotte, NC (USA); 23 Jul 1989. Order Number DE90001606. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An image analysis technique using a scanning electron microscope has been developed for accurately reconstructing grain boundaries to measure small changes in grain size and shape. The technique measures individual grain perimeters, areas, Feret's diameters, lengths, and widths, from which other parameters such as interface area per unit volume (S_v), spherical grain diameter (D), aspect ratio, and shape factor, can be calculated. This technique was applied to study grain growth in microwave versus conventionally annealed alumina. The results demonstrate that the kinetics of grain growth in microwave annealing are significantly faster than those in conventional annealing. This supports the hypothesis that microwaves accelerate either bulk or grain boundary diffusion during the process of grain growth. The microstructural changes resulting from microwave and conventional annealing are similar in terms of grain shape, indicating that the grain growth processes are similar although the kinetics are significantly different. 9 refs., 9 figs., 3 tabs.

52613 (DOE/ER/45090–1) **Radiation damage microstructures in nuclear ceramics with applications in fusion energy technology and nuclear waste disposal: Final technical report.** Hobbs, L.W. Massachusetts Inst. of Tech., Cambridge, MA (USA). Sep 1989. 62p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-84ER45090. Order Number DE90001206. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This final technical report documents the accomplishments of the program of research entitled "Radiation Damage Microstructures in Nuclear Ceramics" funded between July 1984 and July 1988 under DOE Grant FG02-84ER45090. The initial program, begun at MIT in 1983, had as its objective investigation of the radiation responses of ceramics, heavily-irradiated with electrons, neutrons and ions, with potential applications to fusion energy technology and high-level nuclear waste storage. Materials investigated included SiO_2, $MgAl_2O_4$, $Al_{23}O_{27}N_5$, SiC, BeO, $LiAlO_2$, Li_2ZrO_3, $CaTiO_3$, $KTaO_3$ and $Ca(Zr,Pu)Ti_2O_7$. The issues involved have been the subject of a series of DOE-sponsored workshops in which the principal investigator has prominently participated, as well as of two informal collaborative meetings among DOE-supported groups at MIT, Los Alamos, University of New Mexico, Boeing, Oak Ridge National Laboratory and Battelle-Pacific Northwest Laboratory.

52614 (DOE/ER/45102–T2) **The role of mobile ions in fast ion conducting systems and high-impact strength ceramics: Progress report, August 1, 1987–March 1, 1988.** Angell, C.A. Purdue Univ., Lafayette, IN (USA). Dept. of Chemistry. 1988. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-84ER45102. Order Number DE90001521. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The work described in our earlier three year proposal covered several areas of which two have been treated in sufficient detail to warrant reporting at this time. These are the projects dealing with (1) plastic crystals as a basis for a new type of fast ion conductor and (2) systems with mobile ions (essentially fast ion conductors) as impact resistant ceramics. We deal with these in this paper.

52615 (DOE/ER/45266–T2) **Study of high T_c superconducting thin films grown by MOCVD [metalorganic chemical vapor deposition]: Progress report, July 1, 1986–September 30, 1989.** Erbil, A. Georgia Inst. of Tech., Atlanta, GA (USA). School of Physics. [1989]. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-86ER45266. Order Number DE90001669. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In this report, we provide a summary of the progress made during the grant period (July 1, 1986–September 30 ,1989). Initially the focus of this program was on the development of underlying science and technology for the fabrication of metal-semiconductor superlattices. The major motivation for this work was to search for excitonic superconductivity in these structures as predicted by theory, in addition to the obvious microelectronic applications. After the discovery of superconductivity with transition temperatures above 77K, naturally we have turned out attention also to this new class of materials. We describe briefly our work carried under this program on the development of techniques to grow metal-semiconductor superlattices (artificially layered materials) and on the copper oxide based superconductors (naturally layered materials).

52616 (IBP-SA–1/1985) **Temperature-dependent light permeability of glasses.** Meinhardt, S.; Moeschel, J.; Boy, E.; Bertsch, K. Fraunhofer-Institut fuer Bauphysik, Stuttgart (Germany, F.R.). Bereich Waerme/Klima. 26 Apr 1985. 32p. (In German). Order Number DE90711216. Available from NTIS (US Sales Only), PC A03/MF A01.

A substance is developed and presented which, depending on temperature, clouds in a reversible manner, and which is based on an organic polymer mixture. In transparent structural members, the substance can be used for temperature-dependent and automatic sun protection components. By comparison with the existing materials known to fulfil this function in a similar manner, this recent development exhibits a long-term stability; the substance applied is environmentally harmless. Its production process is very simple. In its physical behaviour, the substance shows good properties which can be used in solar engineering. The various ways of applying the system in double and single-pane systems as well as between plastic foils point to a wide scope of application. (orig.) With 2 tabs., 16 figs.

52617 (INIS-BR–1640) **Processing of advanced ceramics using microwaves thermal treatments.** Freitas, C.T. de. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). 1989. 1p. (In Portuguese). Order Number DE90606349. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Published in summary form only. CERAMICS/heat treatments; CERAMICS/microwave radiation; CERAMICS

52618 (IPEN-PUB–253) **Zirconia based ceramics.** Bressiani, J.C.; Bressiani, A.H.A. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). May 1989. 16p. (In Portuguese). Order Number DE90606358. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Within the new generation of ceramic materials, zirconia continues to attract ever increasing attention of scients, technologists and users by virtue of its singular combination of properties and being able to perform thermo-mechanical, electroeletronic, chemico-biological functions. Nevertheless, in order to obtain these properties, a through understanding of the phase transformation mechanisms and microstructural changes is necessary. This paper discusses the main parameters that require control during fabrication of these materials to obtain desired properties for a specific application. (author).

52619 (Juel–2281) **Development of a sinter/HIP cycle for the production of pure, dense Chromia and contributions to determine the diffusion coefficent of hydrogen through Cr_2O_3.** Dueringer, T.K. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Technische Hochschule Aachen (Germany, F.R.). May 1989. 101p. (In German). Order Number DE90711782. Available from NTIS (US Sales Only), PC A06/MF A01.

A sinter/HIP cycle without any capsules and without using any additives is presented to densify Chromia up to its theoretical density. Furthermore experiments will be described to determine the

coefficient of the hydrogen diffusion through Chromia by measuring the hydrogen permeation and by degassing experiments done at chromium oxide powders. The influence of a TiO_2 addition is examined to clear off the most probable diffusing paths of hydrogen through Chromia. (orig.).

52620 (KFK–4598) **Reaction behaviour of B_4C absorber material with stainless steel and Zircaloy in severe LWR accidents.** Hofmann, P.; Markiewicz, M.; Spino, J. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projektgruppe LWR-Sicherheit (PRS). Jul 1989. 50p. Order Number DE90711706. Available from NTIS (US Sales Only), PC A03/MF A01.

The chemical reaction behaviour of B_4C absorber material with 1.4919 stainless steel (AISI 316) and Zircaloy-4 was studied in the temperature range 800-1600^{0}C. The reaction kinetics for both systems can be described by parabolic rate laws. Above 1000^{0}C, the reaction zone growth rates x^2/t in the B_4C/stainless steel system are by about two orders of magnitude higher than those in the B_4C/Zircaloy-4 system. The compatibility specimens are quickly and completely liquefied at about 1250^{0}C for the B_4C/stainless steel reaction couples and at about 1650^{0}C for the B_4C/Zircaloy-4 reaction couples. In both reaction systems the liquefaction occurs below the melting points of the components. (orig.).

52621 (LA–11499-MS) **Ion beam analysis and modification of thin-film, high-temperature superconductors.** Nastasi, M. Los Alamos National Lab., NM (USA). Oct 1989. 25p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. Order Number DE90000918. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The application of ion beams to ceramic processing is a very powerful technique. In particular, ion beams have been shown to be very effective in producing novel material properties through their rather violent interactions with the component atoms of the ceramics. However, in all these cases ions are used to process and produce changes in ceramics, changes that must be monitored by other techniques. This paper shows that, in addition to modifying materials, ion beams can be used in a more gentle but very powerful way to explore what happens to a ceramic thin film as a result of processing. The following discussions are concerned exclusively with a new and exciting class of ceramic: the high-temperature superconductor (HTS). We will discuss the application of various ion beam backscattering techniques as well as examine the use of ion implantation in the processing of these materials. 34 refs., 25 figs.

52622 (LBL–27541) **Origin of the "linear" term in the specific heat of $YBa_2Cu_3O_7$.** Phillips, N.E.; Fisher, R.A.; Gordon, J.E.; Kim, S. Lawrence Berkeley Lab., CA (USA). Jul 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890718–31: International conference on materials and mechanisms of superconductivity - high-temperature superconductors, Stanford, CA (USA), 23-28 Jul 1989). Order Number DE90000166. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We report measurements of the specific heat, C, of a number of samples of YBCO, and interpret the results as showing the existence of localized magnetic moments on the YBCO lattice that suppress the transition to the superconducting state. Both the extent of the transition [as measured, for example, by the "jump" in C at T_c, $\Delta C(T_c)$] and the magnitude of the low-temperature "linear" term in C, $\gamma(0)T$, are correlated with concentration of these moments in the way expected for pair-breaking centers: $\gamma(0)$ increases and $\Delta C(T_c)/T_c$decreases, both linearly, with increasing moment concentration. The contribution to $\gamma(0)$ associated with these pair-breaking centers, together with that previously recognized as arising from impurity phases, accounts completely for the observed $\gamma(0)$. We are not aware of other results that are inconsistent with these correlations, and conclude that there is no contribution to $\gamma(0)$ that is an intrinsic property of the superconducting state in YBCO. 3 refs., 3 figs.

52623 (LBL–27585) **Properties and morphology of doped polycrystalline β''-alumina electrolytes.** Visco, S.J.; Liu, M.; Kimes, P.; De Jonghe, L.C. Lawrence Berkeley Lab., CA (USA). Aug 1989. 5p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. (CONF-891132–5: 9. battery and electrochemical contractors' conference, Alexandria, VA (USA), 13-17 Nov 1989). Order Number DE90000127. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

β''-alumina specimens were fabricated from commercial β''-alumina powders of nominal composition 90.40 wt % Al_2O_3, 8.85 wt % Na_2O, and 0.75 wt % Li_2O. A series of 100 gram samples of the commercial β''-alumina powder were mixed with 0.2 wt % of one of the oxides of germanium (GeO_2), magnesium (MgO), niobium (Nb_2O_5), or zinc (ZnO). Ionic conductivity measurements were performed in the frequency range of 1 Hz to 1 MHz under an argon atmosphere in a quartz furnace, from ambient to 350°C. After analysis by ac impedance, the ceramic electrolytes were notched and fractured for microstructural analysis by optical and scanning electron microscopy. 4 figs.

52624 (ORNL/TM–11239) **Ceramic Technology for Advanced Heat Engines Project: Semiannual progress report for October 1988–March 1989.** Oak Ridge National Lab., TN (USA). Aug 1989. 558p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90001852. Available from NTIS, PC A23/MF A01 - OSTI; GPO Dep.

The Ceramic Technology for Advanced Heat Engines Project was developed by the Department of Energy's Office of Transportation Systems (OTS) in Conservation and Renewable Energy. This project, part of the OTS's Advanced Materials Development Program, was developed to meet the ceramic technology requirements of the OTS's automotive technology programs. Significant accomplishments in fabricating ceramic components for the Department of Energy (DOE), National Aeronautics and Space Administration (NASA), and Department of Defense (DoD) advanced heat engine programs have provided evidence that the operation of ceramic parts in high-temperature engine environments is feasible. However, these programs have also demonstrated that additional research is needed in materials and processing development, design methodology, and data base and life prediction before industry will have a sufficient technology base from which to produce reliable cost-effective ceramic engine components commercially.

52625 (PB–89-211114/XAB) **Brief review of recent superconductivity research at NIST (National Institute of Standards and Technology). Bi-monthly report.** Lundy, D.R.; Swartzendruber, L.J.; Bennett, L.H. National Inst. of Standards and Technology, Gaithersburg, MD (USA). 1989. 32p. Available from NTIS, PC A04.

Included in Jnl. of Research of the National Institute of Standards and Technology, Vol. 94, No. 3, 147-178(May-Jun 1989).

A brief overview of recent superconductivity research at NIST is presented. Emphasis is placed on the new high-temperature oxide superconductors, though mention is made of important work on low-temperature superconductors, and a few historical notes are included. For the new high-temperature superconductors, research activities include determination of physical properties such as elastic constants and electronics structure, development of new techniques such as magnetic-field modulated microwave absorption and determination of phase diagrams and crystal structure. For the low-temperature superconductors, research spans studying the effect of stress on current density to the fabrication of a new Josephson junction voltage standard.

52626 **The mechanical and tribological properties of ion implanted ceramics.** McHargue, C.J. pp. 648 of Ion beam modification of insulators: Volume 2. Mazzoldi, P.; Arnold, G.W. Elsevier Science Pub. Co. Inc., New York, NY (1987).

The surface mechanical properties of ceramics can be altered by ion implantation. The alteration results from the microstructural changes and the residual stresses produced in the implanted zone. Because of difficulties associated with accurate property determination of thin layers, the data are generally qualitative in nature and indicate only the direction of the changes. Implantation conditions which give a damaged but crystalline layer cause increases in hardness, fracture toughness, and flexural strength. If implantation produces an amorphous phase, the hardness decreases but the apparent fracture toughness and the flexural strength may be increased relative to the unimplanted value. These increases have been attributed to the residual compressive stress state. The amorphous surface layer suppresses the incidence of lateral cracking

associated with indentation or scratching with a sharp stylus. Since much of the material that is removed from a brittle solid during a wear test is the result of lateral cracking, implanted ceramics with amorphous surfaces show less wear in laboratory tests than their crystalline counterparts.

52627 **Elastic-recoil-detection measurement of instabilities in proton-exchanged lithium niobate.** Arnold, G.W. (Sandia National Labs., Albuquerque, NM (USA)); Carnera, A.; Mazzi, G.; Mazzoldi, P. vp of Laser and particle-beam chemical processing for microelectronics. Ehrlich, D.J.; Higashi, G.S.; Oprysko, M.M. Materials Research Society, Pittsburgh, PA (1988). (CONF-8711147–: Laser and particle-beam chemical processing for microelectronics, Boston, MA (USA), 30 Nov - 3 dec 1987).

The H and Li profiles in proton-exchanged (PE) $LiNbO_3$ have been measured using elastic recoil detection (ERD). Profiles were determined as a function of crystal orientation, time after PE, annealing temperature, M_gO-doping, and added Li-benzoate to the benzoic acid proteon source. The proton-exchange process produces $H_{chi}Li_{1-chi}NbO_3$ structures where chi stabilizes near values of chi≃0.5 or chi≃0.7-0.75 depending on specific conditions. the ERD measurements represent the first direct and simultaneous measurements of H- and Li-concentrations in PE $LiNbO_3$ and their variation with process parameters.

52628 **Enhanced ultrasonic attenuation in the superconducting state of Ho-rich $Er_{1-x}Ho_xRh_4B_4$.** Sun, K.J. (Physics Department, University of Wisconsin-Milwaukee, Milwaukee, Wisconsin 53201 (US)); Levy, M.; Maple, M.B.; Torikachvilli, M.S. *Physical Review Letters (USA)*, 63(4): 453-456 (24 Jul 1989).

The temperature-dependent and magnetic-field-dependent ultrasonic-attenuation data of Ho-rich $Er_{1-x}Ho_xRh_4B_4$ polycrystalline samples indicate that the attenuation increase observed throughout the superconducting state of this system is associated with the onset and existence of superconductivity. This attenuation behavior is different from any other which has been previously associated with superconductivity, where the attenuation either starts to decrease immediately below T_c or decreases after exhibiting a peak. We suggest that interaction with spin fluctuations or that perhaps a different BCS coherence factor may cause this anomalous behavior.

52629 **Giant superconducting anisotropy in $Bi_2Sr_2Ca_1Cu_2O_{8+\delta}$.** Farrell, D.E. (NASA-Lewis Research Center, Cleveland, Ohio 44135 (US)); Bonham, S.; Foster, J.; Chang, Y.C.; Jiang, P.Z.; Vandervoort, K.G.; Lam, D.J.; Kogan, V.G. *Physical Review Letters (USA)*, 63(7): 782-785 (14 Aug 1989). DOE Contract W-31-109-ENG-38.

Using torque magnetometry, the superconducting anisotropy of a single crystal of $Bi_2Sr_2Ca_1Cu_2O_{8+\delta}$ has been measured in the temperature range $77.5<T<83$ K (T_c=85 K). The data provide direct experimental evidence for a giant anisotropy. A London analysis provides an excellent description of the results and establishes a temperature-independent value of 3×10^3 for the superconducting effective-mass anisotropy.

52630 **Composition and substrate effects on the structure of thin-film $CuGaSe_2$.** Hallak, H. (Solar Energy Research Institute, 1617 Cole Boulevard, Golden, Colorado 80401 (US)); Albin, D.; Noufi, R. *Applied Physics Letters (USA)*, 55(10): 981-983 (4 Sep 1989). DOE Contract AC02-83CH10093.

Two opposite trends in the variation of *d* spacing (2θ) with composition are observed for the (112) peak position in x-ray diffraction patterns for evaporated $CuGaSe_2$ films on different substrates. The 2θ value tends to increase with increasing molecularity for Al_2O_3 and 7059 glass substrates and decreases for Mo-coated Al_2O_3 and 7059 glass substrates. The films are composed of $CuGaSe_2$ plus impurity phases, and the "actual" molecularity of the $CuGaSe_2$ does not exceed 0.5.

52631 **Surface resistance of $YBa_2Cu_3O_7$ films on $SrTiO_3$ and $LaGaO_3$ substrates.** Cooke, D.W.; Gray, E.R.; Houlton, R.J.; Rusnak, B.; Meyer, E.A.; Beery, J.G.; Brown, D.R.; Garzon, F.H.; Raistrick, I.D.; Rollet, A.D.; and others. *Applied Physics Letters (USA)*, 55(9): 914-916 (28 Aug 1989).

Surface resistance measurements of films of $YBa_2Cu_3O_7$ deposited onto single-crystal substrates of $LaGaO_3$ and $SrTiO_3$ have been made at a frequency of 22 GHz. The measurements were made in either a copper or niobium cavity by replacing the end wall with the superconducting film. Typical surface resistance at 20 K are 1–2 mΩ for films on $LaGaO_3$ and 6–8 mΩ for films on $SrTiO_3$, as measured in the copper cavity. The $LaGaO_3$ values lie within the sensitivity range of the Cu cavity (~2 mΩ) and can only be considered upper limits. Similar measurements in a Nb superconducting cavity resulted in a surface resistance value of 0.2±0.1 mΩ at 4 K for the best $LaGaO_3$-based film. This value is more than an order of magnitude lower than Cu, and suggests that $LaGaO_3$-based films may offer immediate advantages in a number of applications.

52632 **Correlation of thermally stimulated luminescence with radio frequency surface resistance of high-temperature superconductors.** Cooke, D.W. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545 (US)); Bennett, B.; Gray, E.R.; Houlton, R.J.; Hults, W.L.; Maez, M.A.; Mayer, A.; Smith, J.L.; Jahan, M.S. *Applied Physics Letters (USA)*, 55(10): 1038-1040 (4 Sep 1989).

We recently demonstrated that insulating surface impurity phases in high-temperature superconductors can be detected by thermally stimulated luminescence. Moreover, we suggested that the intensity of luminescence is related to the magnitude of the rf surface resistance. In this work we show that a quantitative correlation exists between these two quantities, and that luminescence can be a very useful technique for estimating rf surface resistance.

52633 **Influence of oxygen concentration on processing $YBa_2Cu_3O_{7-x}$.** Chen, N. (Argonne National Laboratory, Argonne, Illinois 60439 (US)); Shi, D.; Goretta, K.C. *Journal of Applied Physics (USA)*, 66(6): 2485-2488 (15 Sep 1989). DOE Contract W-31-109-ENG-38.

The sintering kinetics of $YBa_2Cu_3O_{7-x}$ have been studied from 870 to 930 °C in oxygen/argon mixtures ranging from 0.2% to 100% oxygen. For sintering at temperatures below that required for formation of any liquid phase, densification rates increased with decreasing oxygen concentration, and transport critical current densities increased with increasing density. The activation energy for sintering was 190±30 kJ/mol.

52634 **Low-temperature photoluminescence studies of mercuric-iodide photodetectors.** James, R.B. (Theoretical Division, Sandia National Laboratories, Livermore, California 94551-0969 (US)); Bao, X.J.; Schlesinger, T.E.; Markakis, J.M.; Cheng, A.Y.; Ortale, C. *Journal of Applied Physics (USA)*, 66(6): 2578-2584 (15 Sep 1989).

Mercuric-iodide (HgI_2) photodetectors with sputtered indium-tin-oxide (ITO) entrance electrodes were studied using low-temperature photoluminescence spectroscopy. The photoluminescence spectrum obtained on each photodetector was found to differ for points beneath the ITO contact and points adjacent to it, indicating that the contact fabrication process introduces new carrier traps and radiative recombination centers within the ITO-HgI_2 interfacial region. In particular, a new broad band was observed in the spectra taken from points beneath the ITO electrode. Photocurrent-versus-position measurements showed that the intensity of this broad band was enhanced in regions having relatively poor photoresponse.

52635 *Ab initio* **multicenter tight-binding model for molecular-dynamics simulations and other applications in covalent systems.** Sankey, O.F. (Department of Physics, Arizona State University, Tempe, Arizona 85287-1504 (US)); Niklewski, D.J. *Physical Review [Section] B: Condensed Matter (USA)*, 40(6): 3979-3995 (15 Aug 1989).

A new, approximate method has been developed for computing total energies and forces for a variety of applications including molecular-dynamics simulations of covalent materials. The method is tight-binding-like and is founded on density-functional theory within the pseudopotential scheme. Slightly excited pseudo-atomic-orbitals are used to derive the tight-binding Hamiltonian matrix in real space. The method is used to find the electronic states and total energies for a variety of crystalline phases of Si and the Si_2 molecule. Excellent agreement is found with experiment and other first-principles methods. As simple applications of the method, we perform a molecular-dynamics simulated-annealing study of the Si_3 molecule to determine the ground-state configuration, and a

molecular-dynamics simulation of the spectral density function of the Si_2 molecule at high and low excitation levels.

3606 Other Materials

Refer also to citation(s) 51674, 51675, 51783, 52064, 52100, 52101, 52103, 52146, 52249, 52285, 52472, 52473, 52532, 52538, 52554, 52555, 52556, 52557, 52558, 52559, 52561, 52562, 52563, 52564, 52565, 52566, 52567, 52568, 52577, 52584, 52586, 52732, 52908, 52909, 52910, 52933, 52946, 52947, 52954, 53099, 53100, 53101, 53202, 53655, 53907

52636 (AD-A–209009/0/XAB) **Epitaxial GaAs on SOI wafers. Final report, 1 August 1988-31 January 1989.** Salerno, J.P. Kopin Corp., Taunton, MA (USA). 29 Mar 1989. 34p. Available from NTIS, PC A03/MF A01.

The feasibility of the heteroepitaxy of high-quality GaAs on SOI substrates by the OMCVD process was investigated. The motivation for this is the potential to obtain large area GaAs wafers with improved radiation-hardness and, eventually, the monolithic integration of radiation hardened Si and GaAs components. Epitaxial GaAs has been grown on SOI wafers prepared by both isolated silicon epitaxy (ISE) and high-dose oxygen implantation (SIMOX). The use of SIMOX provided an efficient means to obtain SOI wafers with the proper Si surface orientation compatible with a standard GaAs on Si growth technology and an excellent surface morphology was achieved. An optimally oriented ISE surface was apparently not obtained with the resulting surface morphology typical of growth on a singular (100) surface. However, the GaAs grown on ISE shows an improved defect structure while the high-quality oxide/silicon interface characteristic of the ISE process is maintained. A n-channel GaAs on SOI FET profile was achieved by doping during the epitaxy process.

52637 (AD-A–209036/3/XAB) **Radiothermoluminescence studies of polymer solids. Final report, 1 August 1985-31 July 1988.** Buckley, C. Northwestern Univ., Evanston, IL (USA). 1 Apr 1989. 36p. Available from NTIS, PC A03/MF A01.

Radiothermoluminescence (RTL) involves irradiating a solid at low temperature (77K) with ionizing radiation and observing luminescence when heating the sample at a constant rate (10 K/min). Glow peaks are observed at characteristic temperatures which, for polymers, are diagnostic of the onset of thermally activated molecular motions. A scanning electron microscope (SEM) was modified to irradiate polymer samples with medium energy (5-30 keV) electrons. This SEM-RTL device is more convenient and reliable than other techniques which utilize remote radiation sources, though information is confined to the near surface regions of the sample. In particular, the oxygen-free environment of the SEM-RTL experiment permitted observation of high temperature relaxations (up to 150 C or 423 K) for the first time in a number of thermoplastics.

52638 (AD-A–209425/8/XAB) **New structural materials. Final report.** General Sciences, Inc., Plymouth Meeting, PA (USA). 25 Mar 1989. 23p. Available from NTIS, PC A03/MF A01.

New high-temperature structures need to be developed that are based on intermetallic materials and ceramic composites. High density borides and carbides previously have been synthesized by self-propagating high-temperature synthesis using reaction pressing techniques in the absence of external heating. Based on this technique, new materials (dense reinforced structures) were synthesized using titanium boride as a primary matrix, with second-phase brittle components such as carbon particles, carbon cloths, silicon and silicon carbide filaments, as well as ductile second phase additions, such as several forms of nickel or chromium. The effects of the additions on the mechanical and physical properties of those materials were examined as a function of temperature and composition. The interaction of matrix/reinforcement during the exothermic formation was studied. A new filler material also was used with high-temperature resin to demonstrate composites with higher temperature capabilities and low observable properties. The resulting materials were expected to have improved toughness, oxidation resistance, and high-temperature survivability.

52639 (BNL–42544) **Polyelectrolytes with sterically hindered anionic charges.** Yeh, T.F.; Liu, H.; Okamoto, Y.; Lee, H.S.; Skotheim, T.A. Brookhaven National Lab., Upton, NY (USA). 1989. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8906105–1: 2. international symposium on polymer electrolytes, Siena (Italy), 14-16 Jun 1989). Order Number DE90001268. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The central problem in the development of single phase polymer electrolytes with exclusive cation conduction has been inadequate ion mobility due to extensive ion pairing between the mobile cation and the covalently attached anion. We have developed a new class of single ion conducting polymers, or polyelectrolytes, based on highly flexible polysiloxane backbones and attached sterically hindered phenolate anions. The combination of a highly delocalized and sterically enclosed anionic charged separation and consequently enhanced cation mobility. 10 refs., 2 figs.

52640 (BNL–42547) **Polyacrylic acid-modified zinc phosphate conversion coatings for corrosion protection of steel.** Sugama, T.; Kukacka, L.E.; Carciello, N. Brookhaven National Lab., Upton, NY (USA). Jan 1989. 13p. Sponsored by U.S. Department of Defense; U.S. DOE Energy Research. DOE Contract AC02-76CH00016. MIPR-ARO-102-89. (CONF-8910232–1: Tri-service corrosion conference, Atlantic City, NJ (USA), 17-19 Oct 1989). Order Number DE90000533. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Polyacrylic acid, p(AA), electrolyte macromolecules diffused into crystalline zinc phosphate (Zn·Ph) conversion coatings that are precipitated onto cold-rolled steel by dissolution- recrystallization processes, enhance the corrosion protection of steel. One of the specific subserviences was that, when the NaOH- dissolution of Zn·Ph is considered, the Zn-OOC electrostatic bonds at p(AA)-Zn·Ph interfaces are transformed into $Na^{\pm}OOC$ ionic bonds which associate with the salt complexed macromolecules. Another is the intermolecular chemical reactions between p(AA) and polymeric topcoats. These contributions relate directly to a lower cathodic delamination rate. 9 refs., 6 figs., 2 tabs.

52641 (BNL–43251) **Langmuir-Blodgett films of a pyrrole and ferrocene mixed surfactant system.** Samuelson, L.; Rahman, A.K.M.; Clough, S.; Tripathy, S.; Hale, P.D.; Inagaki, T.; Skotheim, T.A.; Okamoto, Y. Brookhaven National Lab., Upton, NY (USA). 1989. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8906205–2: NATO advanced study institute on lower-dimensional systems and molecular electronics, Spetses (Greece), 12-23 Jun 1989). Order Number DE90001328. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Langmuir-Blodgett technique was used to study the molecular organization of a mixed 3-hexadecyl pyrrole (3HDP) and ferrocene-derivatized pyrrole (Fc-Py) surfactant system. It has been determined that stable monolayer films of the mixed system could be formed at the air-water interface. The growth and assembly process led to polypyrrole 2-D lattices with heretofore unsurpassed order. In fact, the process of template polymerization, it appears, leads to a new crystal phase for the polypyrrole component of the thin film structure. Various monolayer and multilayer films were prepared on platinum coated substrates for surface spectroscopic characterization. Near Edge X-Ray Absorption Fine Structure (NEXAFS) studies revealed that highly ordered multilayer structures are being formed. Electrochemical studies have been initiated to determine the feasibility of these films in molecular electronic device applications. 13 refs., 6 figs., 1 tab.

52642 (BNL–43259) **Poly(ethylene oxide) complexed with KI: An x-ray absorption study.** Yang, X.Q.; Chen, J.; Skotheim, T.A.; Okamoto, Y.; denBoer, M.L. Brookhaven National Lab., Upton, NY (USA). [1989]. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8906105–2: 2. international symposium on polymer electrolytes, Siena (Italy), 14-16 Jun 1989). Order Number DE90001571. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Polymer-salt complexes of poly(ethylene oxide) (PEO) and KI have been studied with the technique of Near Edge X-ray Absorption Fine Structure of the K-edge of potassium. The changes observed in the spectra as a function of temperature are compared

with model systems. The results suggests that the oxygen complexation of the potassium ion is reduced at elevated temperatures. 7 refs., 2 figs.

52643 (CONF-890861–3) **Effect of alloying with silver on intermediate-range order in bulk germanium diselenide glasses.** Dejus, R.J.; Le Poire, D.; Price, D.L.; Susman, S.; Volin, K.J. Argonne National Lab., IL (USA). Aug 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. From 13. biennial international conference on amorphous and liquid semiconductors (ICALS-13) and the first international conference on amorphous semiconductor technology (ICAST-1); Asheville, NC (USA); 21-26 Aug 1989. Order Number DE90001413. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Neutron diffraction, inelastic scattering and Raman scattering measurements have been made on well characterized samples of $GeSe_2$ and $Ag_4Ge_3Se_9$ glass. The annoying with Ag causes pronounced effects on both static and dynamic structure, the former characterized by a sharp decrease in the amplitude of the first sharp diffraction peak and the latter by a reduction in the number of modes corresponding to the ν_3 vibrations of a $Ge(Se_{1/2})_4$ tetrahedron and an increase in the number between ν_4 and ν_1. The neutron data are compared with a model based on the consideration of elementary structural units such as $Ge(Se_{1/2})_4$ and $Ag(Se_{1/2})_3$. The Raman spectrum is characterized by the disappearance of the "companion" line in the ν_1 breathing mode upon doping with silver. 11 refs., 4 figs.

52644 (CONF-8811195–, pp. 191-196) **Ion-beam-source studies of hydrogen motion and trapping in silicon.** Seager, C.H. (Sandia National Labs., Albuquerque, NM (USA)); Anderson, R.A. Oak Ridge National Lab., TN (USA). 1988. From MRS symposium on characterization of the structure and chemistry of defects in materials; Boston, MA (USA); 28 Nov - 3 dec 1988. In *Characterization of the structure and chemistry of defects in materials. Proceedings.* Order Number DE89014796. Available from NTIS, PC A25/MF A01.

The authors have investigated the real time diffusion and trapping of hydrogen in silicon with rapid 1 MHz capacitance and current-voltage measurements on boron and phosphorus doped Schottky-barrier and MIS structures. Hydrogen is introduced by implanting hydrogen ions into the front electrodes of these capacitors. As interpreted by numerical modeling, their data from p-type silicon indicate that the 300 K hydrogen diffusivity is $\simeq 10^{-10}$ cm^2/s, that $\simeq$ 10% of the mobile hydrogen is positively charged, and that these ions are trapped at boron acceptors with a capture radius of 70 Å. The behavior of the n-type capacitors was quite different; hydrogenation resulted in the appearance of a dense layer of positive charge quite near the silicon surface, and in some cases negatively charged species which compensate phosphorus donors.

52645 (DOE/ER/45283–4) **[X-ray studies of strain, interface and impurity in semiconductors]: Technical progress report, July 1, 1988–June 30, 1989.** Kao, Yi-Han. State Univ. of New York, Buffalo, NY (USA). Dept. of Physics. [1989]. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER45283. Order Number DE90001525. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In the past years, we have been using the EXAFS techniques to investigate the local structure around various atomic species in different semiconductor and superconductor systems. EXAFS spectra contain information on interatomic distance, coordination number, and disorder, thus are uniquely suited for studying the microstructure in materials where there is a lack of long-range structural order. In our previous studies, EXAFS data were obtained by measuring either x-ray fluorescence or transmission near the K absorption edge of As, In, Ga, Co, Zn, Se, Nb, Ge, Cu, Y, Ba, Fe, O, and Ag. Some EXAFS spectra near the oxygen K edge were obtained by measuring the total electron yield. The materials studied in our EXAFS experiments include InAs/AlSb, InAs/GaAs, InGaAs/InP, $CoSi_2$/Si(111) heterostructures, As-doped Si (Si:As) and Bi (Bi:As), NbGeAl compounds, and chemically-doped Y-Ba-Cu-O superconductor systems. In the cases of semiconductor heterostructures grown by epitaxy and single crystals, fluorescence EXAFS measurements were made exclusively in order to preserve the integrity of these special samples. 11 refs.

52646 (IEIE–8802, pp. 4) **Particle beam technology.** Goino, Youichi (Nissin Electric Co. Ltd., Kyoto (Japan)). Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related to electricity and information.* Available from NTIS (US Sales Only), PC A02/MF A01.

Reports are made on ion implantation system for semiconductor, IVD system, IBS system, ICB system, etching system and PELS analysis device. As to the ion implantation system, high energy ion implantation system has been studied, the applied voltage of which being higher than 200kV. Ion energy by the IVD method is markedly big. The features of the film formed by the IVD method are good adhesion by mixed layers and the changeability of crystalline structures. The IBS system provides a good control on the film formation conditions, and film can be formed at low temperatures with little impurities contained. The features of the ICB system are that the energy per atom is only a few eV which is optimum for film formation, and that thin film with good crystallinity can be formed at low temperatures causing no damage to the substrate. Ion etching is the main trend also for the etching system. Recently, proton energy loss spectrography was developed which enables the measurement of energy loss at high resolution by implanting 100KeV protonic ion. 7 references, 8 figures.

52647 (IEIE–8802, pp. 3) **Manufacturing equipment for semiconductor and N_2 plasma.** Handa, Sakae (Teru Sagami Kabusiki Kaisha (Japan)). Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related to electricity and information.* Available from NTIS (US Sales Only), PC A02/MF A01.

The necessity of plasma processing and the application of nitrogen plasma are described to study the problems to be considered for future application of nitrogen plasma in semiconductor manufacturing equipment. The basic idea in thin film formation is to effectively produce active species to form a good quality film. Study must be made on the difference in the nature of plasma resulting from the generating methods such as power source frequency to clarify the effect on thin film formation. Low processing temperature is not necessarily an advantage. Low temperature processing is required only when all the subsequent processes are performed at low temperatures or when a specific treatment can be made by the use of plasma. The plasma is better to be kept apart from the substrate when active species are used for the process, and placed close to the substrate when the process depends on electric charge. Studies on the production of clean plasma, in-situ control method, etc. are also important. 10 references, 3 tables.

52648 (INIS-mf–12006, pp. 157) **Optically stimulated luminescence (OSL).** Petzold, R.; Wagner, G.A. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Optically stimulated luminescence (OSL) of a natural potassium feldspar was found to be dependent on the absorbed dose of ionizing irradiation. (orig.).

52649 (KURRI-TR–312) **Proceedings of the specialist research meetings on semiconductors with research reactors.** Nishida, Yoshio; Kawakubo, Tetsuya (eds.). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Feb 1989. 139p. (CONF-8812101–: Specialists' workshop on phase transition studies on hydrogen-bonded crystals by neutron and X-ray diffractometries, Kumatori (Japan), 12-13 Dec 1988). Order Number DE90705930. Available from NTIS (US Sales Only), PC A07/MF A01.

Individual papers are processes separately for the data base. (DLC)

52650 (KURRI-TR–312, pp. 29-34) **Radiation effect in and properties of compounds of II-VI group.** Matsuura, Koichi (Tottori Univ. (Japan). Faculty of Engineering). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Feb 1989. (In Japanese).

(CONF-8812110–: Specialist research meeting on semiconductors with research reactors, Kumatori (Japan), 12-13 Dec 1988). In *Proceedings of the specialist research meetings on semiconductors with research reactors.* Order Number DE90705930. Available from NTIS (US Sales Only), PC A07/MF A01.

Samples of compounds of II-VI group are subjected to radiation and heat treatment to introduce F^+EPR centers of ZnS, optical absorption bands with peaks at 2.3 and 2.9eV, and light emission bands with peaks at 1.1 and 1.45eV. Then the samples are annealed. Measurements show that there is a correlation among the defects involving the F^+ centers, optical absorption bands and emission bands formed during these processes. It is concluded that these have the same origin, that is, S ion vacancies. Measurements are made of the temperature dependence of receding color in absorption bands, emission life and non-emission life. These measurements are used to discuss the electron energy level of the F^+ center. The migration energy of the S ion vacancies is estimated at 1.4eV. The shape of the absorption bands is analyzed, leading to a conclusion that the electron-lattice interaction in the F^+ center is related with 'strong coupling', with its ground state being localized. For ZnSe, it is also shown that radiation induces similar absorption bands associated with the F^+ center of ZnS. Effect of gamma-ray irradiation of high-quality ZnTe is measured by admittance spectroscopy. Results indicate that deep levels (Ev + 0.6eV, Ev + 0.8eV), together with donor-type defects, are introduced by gamma-ray irradiation. (N.K.) 52 refs.

52651 (KURRI-TR–312, pp. 47-54) **Radiation effect and optical properties of MgO.** Okada, Moritami (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Feb 1989. (In Japanese). (CONF-8812110–: Specialist research meeting on semiconductors with research reactors, Kumatori (Japan), 12-13 Dec 1988). In *Proceedings of the specialist research meetings on semiconductors with research reactors.* Order Number DE90705930. Available from NTIS (US Sales Only), PC A07/MF A01.

MgO single crystals containing transition metal impurities, such as Cr and Mn, are irradiated with neutrons, and the effect of the irradiation is investigated with optical methods. Immediately after the irradiation, impurity-added MgO single crystals show increased forbidden transitions. When annealing is performed after the irradiation, part of the allowed transitions, as well as the spin forbidden transition of the d electrons, are also increased. The increase in the d electron transition in transition metal impurities in a MgO single crystal is compared with that in crystals of alkaline earth metal fluoride. A study is also made on the increase in spin allowed transition during annealing, which appears to be peculiar to MgO single crystals. Impurity-added MgO crystals irradiated with 0.7 - 3.8 x 10^{18} n/cm^2 of fast neutrons are annealed at different temperature, followed by light absorption analysis at the liquid nitrogen temperature. The transition energy of the d electrons of the Cr^{3+} and Mn^{2+} ion is largely different from that expected from the O_h symmetric position in a MgO single crystal irradiated with neutrons. These crystals may contain a large number of Frenkel defects. If these defects are trapped near the impurity ions, their d electron transitions will undergo large perturbation. The increased transitions are attributed to the spin coupling and complex formation involving F centers. (N.K.).

52652 (KURRI-TR–312, pp. 110-115) **Effect of radiation on quartz glass.** Yamashita, Hiroshi (Government Industrial Research Inst., Osaka, Ikeda (Japan)). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Feb 1989. (In Japanese). (CONF-8812110–: Specialist research meeting on semiconductors with research reactors, Kumatori (Japan), 12-13 Dec 1988). In *Proceedings of the specialist research meetings on semiconductors with research reactors.* Order Number DE90705930. Available from NTIS (US Sales Only), PC A07/MF A01.

Many studies have been reported on the relations of the water content with the radiation resistance of wet silica (containing ~ 1,000 ppm water), but there are large variations among the results of these studies. The present report describes some observations of the effect of previous heat treatment on the behavior of irradiated wet silica. Wet silica samples are irradiated with X-ray and absorption spectra are observed. Two peaks appear at about 4.6eV (N) and 5.7eV (E'), respectively. They increase with increasing irradiation time. The coloring sensitivity increases if heat treatment (1,000degC) is carried out before irradiation. The rate of increase for the N peak is different from that for the E' peak. A wet silica sample subjected to repeated heat treatment-irradiation cycles indicates that the coloring sensitivity increases continuously for about 10 hours and then levels off. Compared with this, dry silica does not show such variations with thermal history, and is much higher in coloring sensitivity. Photoluminescence spectra and photoluminescence excitation spectra of X-ray irradiated synthetic quartz glass are also observed and discussed. (N.K.).

52653 (KURRI-TR–313) **Evaluation of mechanical properties in reactor irradiated oxide ceramics and non-oxide ceramics.** Miyata, Kiyomi; Atobe, Kozo. Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Feb 1989. 39p. (In Japanese). Order Number DE90709976. Available from NTIS (US Sales Only), PC A03/MF A01.

The irradiation effect of reactor irradiated oxides (Al_2O_3 single and polycrystal (S, P), MgO center dotAl_2O_3 (P) and ZrO_2 (P)) and non-oxides (SiC and Si_3N_4) were studied by some mechanical testing methods. The specimens were irradiated up to a dose of 1 x 10^{19} fast neutron/cm^2 (E>0.1 MeV) at 25 and 360 K, respectively. Flexural strength of the specimen was measured at 77 and 300 K using the three-point bending test of miniature-size piece (12 x 2 x 0.5 mm^3). It was shown that this evaluation method was available to estimate the flexural strength of the irradiated ceramics. Vickers hardness (Hv) and Fracture toughness (K_{IC}) for the specimen were also evaluated by the indenter and the indentation microfracture (1M) technique. The mechanical properties of Al_2O_3 (P), MgOcenter dotAl_2O_3 (P), SiC and Si_3N_4 exhibited no significant change even after the irradiation up to a dose of 1 x 10^{19} fast neutron/cm^2 at 360 K. (J.P.N.).

52654 (MLM–3605(OP)) **The utilization of fillers and reinforcements to develop an optimal DAP [diallyl phthalate] molding compound.** Kaye, C.J.; Schneider, R.E.; Katz, H.S.; Milewski, J.V. EG and G Mound Applied Technologies, Miamisburg, OH (USA). 1989. 13p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-88DP43495. (CONF-891037–1: 21. international technical conference of the Society for the Advancement of Materials and Process Engineering (SAMPE), Atlantic City, NJ (USA), 17-19 Oct 1989). Order Number DE90001448. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Diallyl phthalate (DAP) resin-based compounds were formulated and tested. In these formulations, various types of fillers and fiberglass reinforcements were used in different concentrations while taking into consideration packing concepts, optimum aspect (L/D) ratios, resin content, rheology of the molding compound, and ultimately, the compound's performance. These formulations were required for transfer molding without restricting the melt flow through a gate size of less than 1 mm. The end products are very small parts that must conform to stringent dimensional tolerances (typically ±0.05 mm) and exhibit physical properties that exceed the requirements specified by MIL-M-14G without compromising excellent electrical characteristics. These objectives were achieved by changing from chopped glass roving to screened, milled fiberglass, by the use of microspherical fillers, and by improving micro packing which allowed an increase in the total

52655 (N–89-23547, pp. 565-568) **Trapped radiation.** Vampola, A.L.; Stuckey, W.K. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. May 1989. (NASA-CP–3035-PT-2;L–16575-PT-2;NAS–1.55:3035-PT-2;CONF-8806434–: NASA/SDIO space environmental effects on materials workshop, Hampton, VA (USA), 28 Jun - 1 jul 1988). In *NASA/SDIO Space Environmental Effects on Materials Workshop, part 2.* Available from NTIS, PC A12/MF A01.

The vulnerability of spacecraft materials and components to trapped radiation in aerospace environment is considered along with which orbits the radiation effects are most likely to occur. It seems that the effects on organic polymers are embrittlement, change of modulus and coefficient of expansion; on optics the effects are discoloration and distortion. The effects on integrated circuits are also listed.

52656 (N–89-23622) **Theoretical analysis of compatibility of several reinforcement materials with NiAl and FeAl matrices.** Misra, A.K. Sverdrup Technology, Inc., Cleveland, OH (USA). May 1989. 21p. (NASA-CR–182291;E–4796;NAS–1.26:182291;CONF-890130–: 13. annual conference on composites and advanced ceramics, Cocoa Beach, FL (USA), 15-18 Jan 1989). Available from NTIS, PC A03/MF A01.

Final Contractor Report; sponsored by Advanced Ceramics Association.

Several potential reinforcement materials were assessed for their chemical, coefficient of thermal expansion (CTE), and mechanical compatibility with the intermetallic matrices based on NiAl and FeAl. Among the ceramic reinforcement materials, Al2O3, TiC, and TiB2, appear to be the optimum choices for NiAl and FeAl matrices. However, the problem of CTE mismatch with the matrix needs to be solved for these three reinforcement materials. Beryllium-rich intermetallic compounds can be considered as potential reinforcement materials provided suitable reaction barrier coatings can be developed for these. Based on preliminary thermodynamic calculations, Sc2O3 and TiC appear to be suitable as reaction barrier coatings for the beryllides. Several reaction barrier coatings are also suggested for the currently available SiC fibers.

52657 (N–89-23691) **Undercutting of defects in thin film protective coatings on polymer surfaces exposed to atomic oxygen.** Rutledge, S.K.; Mihelcic, J.A. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1989. 10p. (NASA-TM–101986;E–4686;NAS–1.15:101986;CONF-890468–: 16. international conference on metallurgical coatings and equipment exhibit, San Diego, CA (USA), 17-21 Apr 1989). Available from NTIS, PC A02/MF A01.

Protection for polymeric surfaces is needed to make them durable in the low Earth orbital environment, where oxidation by atomic oxygen is the predominant failure mechanism. Thin film coatings of oxides such as silicon dioxide are viable candidates to provide this protection, but concern has been voiced over the ability of these coatings to protect when defects are present in the coating due to surface anomalies occurring during the deposition process, handling, or micrometeoroid and debris bombardment in low Earth orbit. When a defected coating protecting a polymer substrate is exposed to atomic oxygen, the defect provides a pathway to the underlying polymer allowing oxidation and subsequent undercutting to occur. Defect undercutting was studied for sputter deposited coatings of silicon dioxide on polyimide Kapton. Preliminary results indicate that undercutting may be limited as long as the coating remains intact with the substrate. Therefore, coatings may not need to be defect free to give protection to the underlying surface.

52658 (N–89-24460) **Isothermal life prediction of composite lamina using a damage mechanics approach.** Abuelfoutouh, N.M.; Verrilli, M.J.; Halford, G.R. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Jun 1989. 12p. (NASA-TM–102032;E–4775;NAS–1.15:102032;CONF-8906229–: Symposium on high temperature composites, Dayton, OH (USA), 13-15 Jun 1989). Available from NTIS, PC A03/MF A01.

A method for predicting isothermal plastic fatigue life of a composite lamina is presented in which both fibers and matrix are isotropic materials. In general, the fatigue resistances of the matrix, fibers, and interfacial material must be known in order to predict composite fatigue life. Composite fatigue life is predicted using only the matrix fatigue resistance due to inelasticity micromechanisms. The effect of the fiber orientation on loading direction is accounted for while predicting composite life. The application is currently limited to isothermal cases where the internal thermal stresses that might arise from thermal strain mismatch between fibers and matrix are negligible. The theory is formulated to predict the fatigue life of a composite lamina under either load or strain control. It is applied currently to predict the life of tungsten-copper composite lamina at 260 C under tension-tension load control. The calculated life of the lamina is in good agreement with available composite low cycle fatigue data.

52659 (NSS/R–127) **Chemistry and expansion of limestone - Portland cement mortars exposed to sulphate containing solutions.** Atkinson, A.; Haxby, A.; Hearne, J.A. United Kingdom Nirex, Ltd., Harwell (UK). Aug 1988. 60p. Order Number DE90606362. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

Some concretes in sulphate-bearing groundwaters can deteriorate slowly through chemical reactions which cause expansion and stress. The overall process involves diffusion of sulphate into the concrete, chemical reaction with some cement constituents, internal expansion and, finally, physical disruption of the reacted zone. This work addresses the chemical reactions and the expansion resulting from them so that the overall process of sulphate attack can be modelled eventually. The extent and rate of reaction of calcium sulphate with ordinary and sulphate resisting Portland cements (OPC and SRPC) have been measured under various conditions. Additionally, mortar bars were fabricated from OPC, OPC/BFS (blast furnace slag) and SRPC cements with carboniferous limestone and exposed to various sulphate-containing solutions. The linear expansion of the bars was continuously monitored over a period of about 200 days and, after exposure, the bars were analysed in detail. The results show that the bulk expansion during sulphate attack is proportional to sulphur taken up in insoluble ettringite and magnesium (when present) precipitated as brucite. The results are used to rationalise the behaviour of concretes in sulphate-bearing environments. (author).

52660 (PB–89-868897/XAB) **Ultraviolet and electron-beam curing of printing inks. January 1980-August 1987 (Citations from World Surface Coatings Abstracts). Report for January 1980-August 1987.** National Technical Information Service, Springfield, VA (USA). Aug 1989. 92p. Available from NTISPC N01/MF N01.

Supersedes PB–87-857595.

This bibliography contains citations concerning methods, techniques, and applications for the ultraviolet and electron-beam curing of printing inks. Topics include ink compositions, curing methods and equipment, cured-ink evaluations, screen printing inks, photoinitiators, and ink binders. The pollution and safety problems, and future trends of UV- and E-beam-cured printing inks are considered. Applications in screen printing on polyethylene or polypropylene bottles, and decorative printing of glass are also examined. (This updated bibliography contains 237 citations, 63 of which are new entries to the previous edition.)

52661 (SAND–89-1674) **Automated glass fiber drawing.** Smith, W.L. Sandia National Labs., Albuquerque, NM (USA). Sep 1989. 15p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC04-76DP00789. Order Number DE90000894. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The formation of pristine silica fiber sections in an ultra high vacuum environment requires the critical control of production parameters. Glass temperature and fiber draw force must be precisely controlled to produce favorable results. Process control is achieved by automating the operation of a high power CO_2 laser and the acquisition of data with a dedicated microprocessor. This combination, with the integration of ocular control through the application of digital image processing techniques, has subsequently led to a consistent and reproducible means of forming high quality pristine glass fiber test sections on the order of 25 μm to 50μm in diameter. Fibers formed in this manner are tested to failure (in situ) by applying loads at various rates in controlled environments. This report presents the techniques and devices used to develop this automated fabrication and testing system. 2 refs., 5 figs.

52662 (UCID–21753) **Interlaboratory comparison of radiation-induced attenuation in optical fibers: Part 3, Transient exposures.** Friebele, E.J.; Lyons, P.B.; Blackburn, J.C.; Henschel, H.; Johan, A.; Krinsky, J.A.; Robinson, A.; Schneider, W.; Smith, D.; Taylor, E.W. Lawrence Livermore National Lab., CA (USA). Aug 1989. 49p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90000859. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A comparison of the losses induced in step index multimode, graded index multimode and single mode fibers by pulsed radiation exposure has been made among 12 laboratories over a period of 5 years. The recoveries of the incremental attenuations from 10^{-9} to 10^{1} s are reported. Although a standard set of measurement parameters was attempted, differences between the laboratories are

evident; possible origins for these are discussed. 18 refs., 18 figs., 7 tabs.

52663 (UCRL–101108) **Mechanistic modeling of epoxy resins.** Chiao, L. Lawrence Livermore National Lab., CA (USA). 16 Jun 1989. 40p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-48. (CONF-891153–1: 2. topical conference on emerging technologies in materials, San Francisco, CA (USA), 6-9 Nov 1989). Order Number DE89015119. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Epoxy resins are an important class of materials, particularly when used as the matrix for advanced fiber composites. Because material performance is directly related to processing, it is useful to study the cure kinetics of these resins for use in process modeling, design and control. Mechanistic modeling of the cure reactions are shown to offer more flexibility than the empirical rate laws currently used, without being cumbersome or impractical. In this work, amine-catalyzed epoxy reactions are studied. A kinetic model is developed, based on an accepted reaction mechanism, and applied to experimental data from the literature. This model is shown to be able to describe the cure of "real-world" systems, and unlike the empirical rate laws, can account for variations in the resin formulations. Moreover, the mechanistic model, unlike the empirical ones, is capable of estimating the concentrations of linkages formed during the cure reactions. These data offer insight into the cured resin morphology, which determines the chemical and physical properties of the material. A composite cure model is developed using the mechanistic kinetics. Results from the model are compared to experimental data from the literature, and the effects of resin formulation and cure cycle changes are investigated. 29 refs., 10 figs., 3 tabs.

52664 **High temperature implantation of single crystal beta silicon carbide thin films.** Edmond, J.A. (Oak Ridge Nat. Lab., Oak Ridge, TN); Withrow, S.P.; Wadlin, W.; Davis, R.F. pp. 811 of Interfaces, superlattices, and thin films. Dow, J.D.; Schuller, I.K Materials Research Society, Pittsburgh, PA (1987). (CONF-8612131–: Materials Research Society symposium on interfaces, superlattices and thin films, Boston, MA (USA), 1-6 Dec 1986).

Ions of aluminum, gallium and nitrogen were implanted into (100) oriented β-SiC thin films at temperatures of 623K, 823K and 1023K. Rutherford backscattering/ion channeling analyses revealed that implantation of any one of the ionic species at 623K resulted in only slight crystal lattice damage. In comparison, implantation, conducted using the same dosimetry and energy at room temperature resulted in extensive lattice damage; in the case of gallium, amorphization occurred. The backscattered yield from samples implanted at 1023K was nearly that of a virgin aligned spectra. This in situ annealing effect did not, however, result in the complete electrical activation of implanted species. In order to increase the percent of electrical activation, samples were annealed at 1473K for 1800s following implantation. Differential capacitance-voltage, spreading resistance and sheet resistance measurements were made in order to electrically characterize these layers. These measurements indicated the activation of p-type and n-type species in samples implanted with aluminum or gallium and nitrogren, respectively. The authors have previously reported p-type formation in β-SiC implanted with aluminum at room temperature following a 2073K - 300s anneal. By heating to 1023K during implantation and annealing at 1473K after implantation, improved structural and electrical properties have been achieved.

52665 **The structure of Al/GaAs interfaces.** Liliental-Weber, Z. (Lawrence Berkeley Lab., Berkeley, CA); Nelson, C.; Gronsky, R.; Washburn, J.; Ludeke, R. pp. 811 of Interfaces, superlattices, and thin films. Dow, J.D.; Schuller, I.K Materials Research Society, Pittsburgh, PA (1987). (CONF-8612131–: Materials Research Society symposium on interfaces, superlattices and thin films, Boston, MA (USA), 1-6 Dec 1986).

The structure of Al/GaAs interfaces was investigated by high resolution electron microscopy. The Al layers were deposited in a molecular beam epitaxy chamber with a vacuum base pressure of $<1X10^{-8}$ Pa. The GaAs substrate temperature varied during Al deposition from -30^{0}C to 400^{0}C. Deposition of Al on cold substrates $\leq$25^{0}C resulted in epitaxial growth of (001) Al on (001) GaAs. Droplets of Ga were observed in samples with the substrate temperature at -30^{0}C (1X2) and 0^{0}C (c(2X8)). Postannealing of the last sample caused formation of the AlGaAs phase. Deposition of Al on hot substrates (150^{0}C and 400^{0}C) resulted in the formation of the AlGaAs phase, which separated (110) oriented Al from (001)GaAs.

52666 **Characterization of the α-SN/CDTE(110) interface by angle-resolved X-ray photoemission.** Lin, T.S. (Northwestern Univ., Evanston, IL); Partin, W.J.; Chung, Y.W. pp. 811 of Interfaces, superlattices, and thin films. Dow, J.K.; Schuller, I.K Materials Research Society, Pittsburgh, PA (1987). (CONF-8612131–: Materials Research Society symposium on interfaces, superlattices and thin films, Boston, MA (USA), 1-6 Dec 1986).

Stoichiometric and atomically clean CdTe(110) surfaces have been prepared by suitable chemical etching, followed by argon sputtering, and sample annealing in ultra-high vacuum. Cubic (α) -tin was grown on CdTe(110) by tin evaporation from a tungsten filament at a substrate temperature of 30^{0}C. Angle-resolved X-ray photoelectron spectroscopy (ARXPS) was used to determine the α-Sn growth mechanism and the composition profile of this semiconductor heterostructure nondestructively. From their analyses, the authors conclude that α-Sn grows on CdTe(110) at 30^{0}C by a layer by layer mechanism and forms an abrupt junction with CdTe(110).

52667 **Theoretical investigation of twist boundaries in germanium.** Payne, M.C. (Massachusetts Institute of Technology, Cambridge, MA); Bristowe, P.D.; Joannopoulos, J.D. pp. 811 of Interfaces, superlattices, and thin films. Dow, J.D.; Schuller, I.K Materials Research Society, Pittsburgh, PA (1987). (CONF-8612131–: Materials Research Society symposium on interfaces, superlattices and thin films, Boston, MA (USA), 1-6 Dec 1986).

Results of the first completely ab-initio investigation of the microscopic structure of a grain boundary in a semiconductor are presented. Using the molecular dynamics simulated annealing method for performing total energy calculations within the LDA and pseudopotential approximations, the Σ=5(001) twist boundary in germanium is studied. A low energy structure is identified which exhibits a rigid body translation and a small contraction at the boundary.

52668 **Transition from schottky limit to bardeen limit in the Schottky barrier formation of Al on n- and p-GaAs(110) interfaces.** Chin, K.K. (Univ. of Notre Dame, Notre Dame, IN); Cao, R.; Kendelewicz, T.; Miyano, K.; Williams, M.D.; Doniach, S.; Lindau, I.; Spicer, W.E. pp. 811 of Interfaces, superlattices, and thin films. Dow, J.D.; Schuller, I.K Materials Research Society, Pittsburgh, PA (1987). (CONF-8612131–: Materials Research Society symposium on interfaces, superlattices and thin films, Boston, MA (USA), 1-6 Dec 1986).

Schottky barrier formation at room temperature (RT) and low temperature (LT) is studied by photoemission. In the low Al coverage regime (from 0.001 to about 1 ML), it is found that, compared to RT pinning behavior, the n-GaAs(110) surface band bending is attenuated, while the p-GaAs(110) surface band bending is enhanced. This striking phenomenon indicates that, by lowering the substrate temperature, one reduces the disturbance of the GaAs(110) surface, and the surface Fermi level of the n- and p-GaAs (110) tends to go to the same position, the so-called Schottky limit that characterizes a perfect defect-free interface. However, and the coverage increases (up to 30 ML), a new mechanism (in the framework of the unified defect model, it is the formation of defect levels due to the energy released as the adsorbed Al atoms start to form clusters and replace Ga) associated with a disturbed surface becomes dominant. Thus, the LT Fermi level positions of n- and p-GaAs move towards the RT positions, the so-called Bardeen limit. This demonstrates that, by controlling the surface disturbance, one can modify the Schottky barrier formation process, going from the Schottky limit which does not have pinning centers to the Bardeen limit which suggests the existence of pinning centers.

52669 **Transition metal ion species in glass.** White, W.B. (Materials Research Lab., The Pennsylvania State Univ., Univ. Park, PA (US)); Knight, D.S. vp of Defects in glasses. Galeener, F.L.; Griscom, D.L.; Weber, M.J. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, Boston, MA (USA), 2-7 Dec 1985).

Optical absorption spectra of d-d transitions can be interpreted through crystal field theory as evidence for at least four kinds of species: traditional network modifier ions (Mn^{2+}, Fe^{2+}, and Ni^{2+}),

octahedral complexes (Cr^{3+}, Mn^{3+}), tetrahedral complexes (Co^{2+}, Fe^{3+}), and network-forming ions (Ti^{4+}, Fe^{3+}). Absorption spectra measure only majority species since crystal field bands are broad and overlapping. Luminescence spectra reveal minority species if these species happen to be efficient emitters under laser excitation. Doublet-quartet emission bands (Cr^{3+}) are independent of crystal field but allow the distinction between species because of small differences in bonding which shifts the Racah B parameter. Quartet-sextet emission (Mn^{2+}, Fe^{3+}) is strongly dependent on coordination number and bond lengths. Qualitative, but not quantitative, changes in speciation can be followed as glass composition is varied. Conceptually, the complexation of transition metal ions in insulator glasses results from a competition between the transition metal and the glass-forming framework for p-orbital electrons of non-bridging oxygens. Complexation is further enhanced in clustered glasses where the ions segregate into the more depolymerized units.

52670 Transition-metal ions in Nd-doped glasses. Stokowski, S.E. (Lawrence Livermore National Lab., Univ. of California, P.O. Box 5508, L-490, Livermore, CA (US)); Krashkevich, D. vp of Defects in glasses. Galeener, F.L.; Griscom, D.L.; Weber, M.J. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, Boston, MA (USA), 2-7 Dec 1985).

The authors have measured transition-metal ion (Ti, V, Cr, Mn, Fe, Co, Ni, Cu) spectra and their effects on Nd fluorescence quenching in Nd-doped phosphate and silicate glasses. Their purpose was to determine the maximum allowable impurity content given particularly limits on the absorption loss at 1053 nm and the Nd fluorescence quenching rate. To keep the absorption loss <0.1 m^{-1} the transition-metal impurity content should be kept below 0.5 ppmw. To keep the increase in the Nd fluorescence decay rate below 1%, the impurity content should be <3 ppmw. They have also found that the Nd quenching rates do not scale as predicted by Forster-Dexter dipole-dipole energy transfer theory if they assume that the dominant variation with transition metal is the overlap integral of the Nd fluorescence spectrum and the transition-metal absorption. They suggest the phonon-assisted energy transfer to transition metals is effective in quenching Nd. They find that quenching rates increase 1.5 to 4 times as the Nd concentration increases from 0.5 to 10 x 10^{20} cm^{-3}.

52671 Identification of transition metal sites in fused SiO_2 by x-ray absorption spectroscopy. Lytle, F.W. (The Boeing Co., Seattle, WA (US)); Greegor, R.B. vp of Defects in glasses. Galeener, F.L.; Griscom, D.L.; Weber, M.J. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, Boston, MA (USA), 2-7 Dec 1985).

X-ray absorption spectroscopy is used to determine valence and site symmetry for all the 3d transition metals in fused quartz prepared by the flame hydrolysis method. The results are compared with optical data on the same samples with generally good agreement.

52672 Defects in gel-derived glasses. Brinker, C.J. (Sandia National Labs., P.O. Box 5800, Albuquerque, NM (US)); Tallant, D.R.; Roth, E.P.; Ashley, C.S. vp of Defects in glasses. Galeener, F.L.; Griscom, D.L.; Weber, M.J. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, Boston, MA (USA), 2-7 Dec 1985).

Defects in gel-derived glasses were reviewed for the three principal stages of the sol-gel process: solution, porous gel, and consolidated glass. The most prominent defects in gel-derived SiO_2 are Raman active defects characterized by sharp bands at 490 cm^{-1}(D_1) and 608 cm^{-1}(D_2). ^{18}O enrichment, experimental estimates of heats of formation, and structural studies of cyclic model compounds were used to identify the structural origins of D_1 and D_2 in gels. The authors conclude that D_1 and D_2 in gel-derived SiO_2 are the oxygen breathing modes of 4- and 3-fold siloxane rings, respectively, as originally proposed by Galeener to explain these Raman-active defects in conventional vitreous silica (v-SiO_2). During heat treatments near T_g (defined by eta = $10^{13.5}$ poises), the gel-derived SiO_2 structure rapidly approaches that of conventional v-SiO_2.

52673 Control of solid-excitation-based photochemical dry etching of semiconductors by ion-bombardment-induced damage. Ashby, C.I.H. (Sandia National Labs., Albuquerque, NM (USA)); Myers, D.R. vp of Laser and particle-beam chemical processing for microelectronics. Ehrlich, D.J.; Higashi, G.S.; Oprysko, M.M. Materials Research Society, Pittsburgh, PA (1988). (CONF-8711147–: Laser and particle-beam chemical processing for microelectronics, Boston, MA (USA), 30 Nov - 3 dec 1987).

Carrier-driven photochemical dry etching of semiconductors can be selectively suppressed by ion-implantation-induced defects. The magnitude of this suppression depends on the semiconductor impurity dipping concentration, the ion fluence, and the photo-excitation wavelength.

52674 Atomistic calculation of stability and metastability of coherently strained silicon-like structures. Dodson, B.W. (Sandia Nat. Labs., Albuquerque, NM); Taylor, P.A. pp. 811 of Interfaces, superlattices, and thin films. Dow, J.D.; Schuller, I.K Materials Research Society, Pittsburgh, PA (1987). (CONF-8612131–: Materials Research Society symposium on interfaces, superlattices and thin films, Boston, MA (USA), 1-6 Dec 1986).

Monte Carlo based microscopic techniques were used to study the stability and metastability of thin coherently strained layers of mismatched silicon-like semiconductor material grown on the (111) silicon surface. The structural energy was calculated using three-body empirical potentials. For layers greater than about 20 A thickness, the critical layer thickness associated with thermodynamic stability agrees quantitatively with continuum theory. For thinner layers, however, considerable variations from the continuum theory are found. For a strained layer six monolayers thick, the test system is found to be metastable against the nucleation of misfit dislocations to a lattice mismatch of about 11%, compared to the 4% equilibrium stability limit.

52675 Direct observation of valence-band mixing in GaAs/GaPAs strained-layer superlattices. Jones, E.D. (Sandia Nat. Lab., Albuquerque, NM); Biefeld, R.M.; Fritz, I.J.; Gourley, P.L.; Osbourn, G.C.; Schirber, J.E.; Heiman, D.; Foner, S. pp. 811 of Interfaces, superlattices, and thin films. Dow, J.D.; Schuller, I.K Materials Research Society, Pittsburgh, PA (1987). (CONF-8612131–: Materials Research Society symposium on interfaces, superlattices and thin films, Boston, MA (USA), 1-6 Dec 1986).

Low-temperature magneto-luminescence studies are used to examine the in-plane valence-band dispersion in GaAs/GaPAs strained-layer-superlattice structures. The results provide a direct observation of valence-band mixing effects in strained-layer systems.

52676 Photoemission study of the physical nature of the InP near-surface defect states. Chin, K.K. (Univ. of Notre Dame, Notre Dame, IN); Cao, R.; Kendelewicz, T.; Miyano, K.; Yeh, J.J.; Doniach, S.; Lindau, I.; Spicer, W.E. pp. 811 of Interfaces, superlattices, and thin films. Dow, J.D.; Schuller, I.K Materials Research Society, Pittsburgh, PA (1987). (CONF-8612131–: Materials Research Society symposium on interfaces, superlattices and thin films, Boston, MA (USA), 1-6 Dec 1986).

The physical nature of the InP near-surface defect acceptor and donor states are studied by using photoemission spectroscopy. It is found that the In/n-InP(110) interface band bending does not start until the In coverage reaches about 0.3 monolayer (ML), while the In/p-InP(110) band bending is almost saturated at 0.3 ML. The annealing effect on the band bending of clean cleaved n- and p-type InP(110) surfaces is also studied. It is found that annealing of the clean surface creates an irreversible band bending effect on the p-InP(110), but the n-InP(110) almost does not show any band bending after low temperature annealing. Based on these two striking differences in the band bending behavior of n- and p-type InP, it is proposed that the physical nature of InP near-surface defect acceptor and donor levels may be different and that phosphorus vacancies are the cause of p-InP surface Fermi level pinning.

52677 Stress release in ion implanted lattice mismatched semiconductor heterostructures. Arnold, G.W. (Sandia Nat. Lab., Albuquerque, NM); Picraux, S.T.; Myers, D.R.; Doyle, B.L.; Peercy, P.S.; Biefeld, R.M.; Dawson, L.R. pp. 811 of Interfaces, superlattices, and thin films. Dow, J.D.; Schuller, I.K Materials Research

Society, Pittsburgh, PA (1987). (CONF-8612131–: Materials Research Society symposium on interfaces, superlattices and thin films, Boston, MA (USA), 1-6 Dec 1986).

Cantilever-beam measurements of ion-implantation induced stress in (InGa)As/GaAs, Ga(AsP)/GaP, and Ga(AsP)/GaAs strained layer superlattices (SLSs), grown either by molecular-beam epitaxy (MBE) or metalorganic chemical vapor deposition (MOCVD), have shown that a mechanism for precipitous stress-relief can be operative for room-temperature damage-energy deposition values above $\sim 2 \times 10^{20}$ keV/cm^3. This phenomenon is correlated with the initial residual compressive stress on the composite structure and is determined by the differences in lattice parameter between the substrate and the buffer alloy-layer.

52678 The mixed alkali effect in sodium rubidium germanate glasses. Mundy, J.N. (Materials Science and Technology Div., Argonne National Lab., Argonne, IL (US)); Jin, G.L. vp of Defects in glasses. Galeener, F.L.; Griscom, D.L.; Weber, M.J. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, Boston, MA (USA), 2-7 Dec 1985).

The lack of general applicability of the many theoretical models for the mixed alkali effect (MAE) in glasses is briefly reviewed. Although the MAE appears to be related to the bonding affinity of alkali ions to charge compensating centers in the glass network, experimental scatter and the difficulty of comparing different glass networks have prevented systematic tests of this relationship. The present paper discusses why the mixed alkali germanate glasses should provide a glass system where the concentration and strength of charge-compensating centers can be systematically varied and the relationship to the MAE tested. Such tests are only possible if the ionic conductivity of a series of mixed alkali germanate glasses can be measured in a reproducible manner. The measurements of the ionic conductivity of two series of chi$(Na,Rb)_2O$:(1-chi)GeO_2 glasses, with chi = 0.19 and chi = 029, respectively, suggest the necessary reproducibility can be attained.

52679 Influence of quenched defects on thermal expansion and glass transition in diopside ($CaMgSi_2O_6$). Raman, S.V. (Brookhaven National Lab., Upton, NY (US)). vp of Defects in glasses. Galeener, F.L.; Griscom, D.L.; Weber, M.J. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, Boston, MA (USA), 2-7 Dec 1985).

This study was conducted to investigate the possible occurrence of non-equilibrium defects and their influence on glass transition in a relatively depolymerized silicate structure. The glass of interest has an average bridging/non-bridging oxygen ratio of 1:2. It was prepared by fast quenching and was examined in the alumina pushrod dilatometer at heating rates of 5 and 15^{0}C/min. The thermal expansion decreases with increase in the rate of heating although, the expansion coefficient is independent of heating rate at temperatures below the transition region. In the super-cooled liquid region the expansion coefficient is higher at the higher heating rate. In the transition region it is both heating rate and temperature dependent. Three distinct temperatures are revealed in the transition region from temperature dependence of expansion rate. Their dependence ion heating rate is described by a low activation energy of about 3Kcal/mol for transition. The single parameter fictive temperature is not in agreement with kinetics of relaxation due to a wide temperature interval of 600 to 750^{0}C for the transition region. The transition kinetics is perhaps enhanced by the presence of defects whose annealing is impedded with increase in heating rate.

52680 Epitaxial film growth of single crystal Ce/V prepared by molecular-beam epitaxy. Homma, H. (Argonne Nat. Lab., Argonne, IL); Yang, K.Y.; Schuller, I.K. pp. 811 of Interfaces, superlattices, and thin films. Dow, J.D.; Schuller, I.K Materials Research Society, Pittsburgh, PA (1987). (CONF-8612131–: Materials Research Society symposium on interfaces, superlattices and thin films, Boston, MA (USA), 1-6 Dec 1986).

The growth of epitaxial films of cerium (Ce)/vanadium (V)/on single crystal sapphires (α-Al_2O_3) was studied by in-situ reflection high energy electron diffraction and x-ray scattering. For the first time Ce(111) single crystal film was grown on V(110)/α-Al_2O_3(112-bar0) in the Frank-van der Merwe mode. A new epitaxial orientation, different from the well known Nishiyama-Wasserman or Kurdjumov-Sachs orientation is found in the present study. Subsequent V(110) layers grow epitaxially with three equivalent domains.

52681 Photoemission study of the a-Si-H/a-SiO_x:H and a-Si:H/a-SiN:H interface formation. Eberhardt, W. (Brookhaven Nat. Lab., Upton, NY); Abeles, B.; Yang, L.; Stasiewski, H.; Sondericker, D. pp. 811 of Interfaces, superlattices, and thin films. Dow, J.D.; Schuller, I.K Materials Research Society, Pittsburgh, PA (1987). (CONF-8612131–: Materials Research Society symposium on interfaces, superlattices and thin films, Boston, MA (USA), 1-6 Dec 1986).

The authors report a study of the interface formation between a-Si:H and a-SiO_x:H or a-SiN:H in the coverage regime from a submonolayer to a few layers. The films were grown by plasma assisted CVD and characterized by photoemission. The authors' studies show that the growth mechanism is different for a-SiO_x:H on a-Si:H than for a-Si:H on a a-Si:O_x:H. The growth of the a-SiN_x:H/a-Si:H interface on the other hand is independent of the direction.

52682 Core and valence levels in hydrogenated amorphous silicon. Burnham, N.A. (Solar Energy Institute, Golden, CO); Fisher, R.F.; Asher, S.E.; Kazmerski, L.L.; Lucovsky, G.; Parsons, G.N. pp. 811 of Interfaces, superlattices, and thin films. Dow, J.D.; Schuller, I.K Materials Research Society, Pittsburgh, PA (1987). (CONF-8612131–: Materials Research Society symposium on interfaces, superlattices and thin films, Boston, MA (USA), 1-6 Dec 1986).

Silicon core and valence levels were studied in hydrogenated amorphous silicon (a-Si:H) as a function of hydrogen concentration. The techniques used to establish the core levels were X-ray Photoelectron Spectroscopy and core-level Electron Energy Loss Spectroscopy. Changes in the local densities of states of the silicon 3s and 3p levels were examined with Auger Electron Spectroscopy. The a-Si:H samples were grown by RF sputtering. Their hydrogen concentrations varied from zero to nearly fifteen percent.

52683 Neutron activation analysis for contamination control in device processing. Riley, J.E. Jr. *Transactions of the American Nuclear Society (USA),* 56: 225 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The current state of silicon semiconductor device development seeks to produce large numbers of marketable devices with design rules of <1 μm-dimensions of 0.5 μm will appear in the near future with 0.25 μm soon to follow. The role of neutron activation analysis in the device-oriented analytical laboratory is to attack those problems that require accurate determinations of very low level impurities using long and short irradiations tailored to the specific elements of interests. The Murray Hill laboratory device development monitors a set of key processing steps to maintain control of contaminants that lower device yields, including those elements originating from the personnel and the environment of the clean room. The environment of the finished device is an important consideration in proper operation since single-event upsets caused by the interaction of alpha particles with sensitive devices generate 100 to 10,000 times more electrons than used in normal device operation. The radioactive contaminants responsible for most of these events were found to have been included during device fabrication or in packaging.

52684 Neutron activation for semiconductor materials characterization at Eastman Kodak Company. Hossain, T.Z. *Transactions of the American Nuclear Society (USA),* 56: 225-226 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Several neutron activation analysis (NAA) procedures have been used to establish process parameters in the manufacture of semiconductor devices. In addition to instrumental NAA (INAA), techniques such as neutron depth profiling and neutron-activated accelerator mass spectrometry have been used to obtain depth distribution of elements of interest.

52685 Model of phonon-associated electron tunneling through a semiconductor double barrier. Cai, W. (Department of Physics, City College of the City University of New York, New York, New York 10031 (US)); Zheng, T.F.; Hu, P.; Yudanin, B.; Lax, M. *Physical Review Letters (USA),* 63(4): 418-421 (24 Jul 1989).

We propose an approach to study one-dimensional electron tunneling in an arbitrarily shaped barrier in the presence of electron-optical phonon scattering. An independent-boson model is used for the electron-phonon interaction. Our result for a double-barrier structure shows the occurrence of phonon-assisted resonant tunneling.

52686 **Resonant dielectronic and direct excitation in crystal channels.** Datz, S.; Vane, C.R.; Dittner, P.F.; Giese, J.P.; Gomez del Campo, J.; Jones, N.L.; Krause, H.F.; Miller, P.D.; Schulz, M.; Schone, H.; and others. *Physical Review Letters (USA),* 63(7): 742-745 (14 Aug 1989).

We have observed dielectronic and direct excitation of H-like S^{15+} and Ca^{19+} and He-like Ti^{20+} ions in silicon channels caused by collision with weakly bound target electrons which behave as a free-electron gas. As *in* acuo, relaxation of the doubly excited states can occur radiatively leading to ions of decreased charge, but in a crystal channel collisional effects can cause double ionization. The effects are seen in both the x-ray yields and charge-state fractions, and, in the case of Ti^{20+}, in charge-state x-ray coincidences.

52687 **Heteroepitaxial growth of Ge films on (100) GaAs by pyrolysis of digermane.** Eres, D. (Solid State Division, Oak Ridge National Laboratory, P.O. Box 2008, Building 2000, Oak Ridge, Tennessee 37831-6056 (US)); Lowndes, D.H.; Tischler, J.Z.; Sharp, J.W.; Geohegan, D.B.; Pennycook, S.J. *Applied Physics Letters (USA),* 55(9): 858-860 (28 Aug 1989). DOE Contract AC05-84OR21400.

Pyrolysis of high-purity digermane (Ge_2 H_6) has been used to grow epitaxial Ge films of high crystalline quality on (100) GaAs substrates in a low-pressure environment. X-ray double-crystal diffractometry shows that fully commensurate, coherently strained epitaxial Ge films can be grown on (100) GaAs at digermane partial pressures of 0.05–40 mTorr for substrate temperatures of 380–600 °C. Amorphous films also were deposited. Information about the crystalline films surface morphology, growth mode, and microstructure was obtained from scanning electron microscopy, cross-section transmission electron microscopy, and *in situ* reflectivity measurements. The amorphous-to-crystalline transition temperature and the morphology of the crystalline films were both found to depend on deposition conditions (primarily the incidence rate of Ge-bearing species and the substrate temperature). Epitaxial growth rates using digermane were found to be about two orders of magnitude higher than rates using germane (GeH_4) under similar experimental conditions.

52688 **Vacuum ultraviolet photoelectron spectroscopy of $(NH_4)_2S$-treated GaAs (100) surfaces.** Spindt, C.J. (Stanford Electronics Laboratories, Stanford University, Stanford, California 94035 (US)); Liu, D.; Miyano, K.; Meissner, P.L.; Chiang, T.T.; Kendelewicz, T.; Lindau, I.; Spicer, W.E. *Applied Physics Letters (USA),* 55(9): 861-863 (28 Aug 1989).

The surface chemistry and band bending of the ammonium sulfide-treated GaAs (100) surface has been studied using surface-sensitive synchrotron radiation photoemission spectroscopy. We find that the treatment leaves the GaAs surface terminated with roughly a monolayer of sulfur bonded to both As and Ga atoms. An *n*-type barrier height of 0.8 eV is measured. The thermal stability of the various chemical components is studied and various issues of the passivating mechanism are discussed.

52689 **Self-interstitials and the 935 cm^{-1} band in silicon.** Stein, H.J. (Sandia National Laboratories, Albuquerque, New Mexico 87185 (US)). *Applied Physics Letters (USA),* 55(9): 870-872 (28 Aug 1989). DOE Contract AC04-76DP00789.

Substitutional carbon in Czochralski Si is found to decrease the formation rate for a 935 cm^{-1} infrared absorption band under neutron irradiation while that for a 965 cm^{-1} band (interstitial carbon trapped at interstitial oxygen) increases. The observations support a controversial previous assignment of the 935 cm^{-1} band to a center with interstitial Si trapped by interstitial oxygen.

52690 **Thermal conductivity of the charge-density-wave systems $K_{0.3}MoO_3$ and $(TaSe_4)_2I$ near the Peierls transition.** Kwok, R.S. (Department of Physics and Solid State Science Center, University of California, Los Angeles, California 90024 (US)); Brown, S.E. *Physical Review Letters (USA),* 63(8): 895-898 (21 Aug 1989).

We report on measurements of the thermal conductivity κ_T close to the Peierls transition temperature T_P in $K_{0.3}MoO_3$ and $(TaSe_4)_2I$. In both cases there is an enhancement of κ_T that peaks at the transition. Simultaneous measurements of the specific heat suggest that the anomalous behavior is a result of mode occupation rather than changes in electron- or phonon-scattering processes.

52691 **Rapid heteroepitaxial growth of Ge films on (100) GaAs by pulsed supersonic free-jet chemical beam epitaxy.** Eres, D. (Solid State Division, Oak Ridge National Laboratory, P. O. Box 2008, Building 2000, Oak Ridge, Tennessee 37831-6056 (US)); Lowndes, D.H.; Tischler, J.Z. *Applied Physics Letters (USA),* 55(10): 1008-1010 (4 Sep 1989). DOE Contract AC05-84OR21400.

Very high epitaxial growth rates (0.25 μm/s), not attainable by conventional vapor phase film growth methods, have been obtained using a pulsed supersonic free jet to supply digermane (Ge_2H_6) for thermal decomposition at a heated (100)GaAs surface. Double-crystal x-ray diffractometry and scanning electron microscopy show that highly planar, smooth, and commensurate epitaxial Ge films are grown on (100)GaAs using gas pulses of 250 ms duration at 1–3 atm (0.1–0.3 MPa) pressure for substrate temperatures of 480–680 °C. It is believed that the very high growth rates effectively "freeze" the Ge-GaAs interface resulting in minimal interfacial diffusion and reduced incorporation of impurities from the surrounding growth environment.

52692 **Thermal conductivity of $La_{3-x}R_xS_4$ where R=Sm, Eu, and Yb.** Kokos, G.B. (Ames Laboratory and Department of Materials, Science and Engineering, Iowa State University, Ames, Iowa 50011 (US)); Gschneidner, K.A. Jr.; Cook, B.A.; Beaudry, B.J. *Journal of Applied Physics (USA),* 66(6): 2356-2362 (15 Sep 1989). DOE Contract W-7405-ENG-82.

The thermal diffusivity values of $La_{2.7}Sm_{0.3}S_4$, $La_{2.3}Sm_{0.7}S_4$, $La_{2.7}Eu_{0.3}S_4$, $La_{2.2}Eu_{0.8}S_4$, $La_{2.8}Yb_{0.2}S_4$, and $La_{2.3}Yb_{0.7}S_4$ were measured by the flash diffusivity method from 400 to 1000 °C. The values ranged from 0.007 to 0.018 cm^2 /s. The thermal conductivities of the six ternary rare-earth sulfides were calculated from the thermal diffusivity data and ranged from 10.7 to 31.6 mW/cm °C. Of the alloys measured, $La_{2.2}Eu_{0.8}S_4$ had the highest thermoelectric figure of merit at 1000 °C (0.52×10^{-3} $°C^{-1}$). All of the samples had an oxysulfide present at the grain boundaries which degraded their high-temperature performance.

52693 **Molecular-dynamics study of lattice-defect-nucleated melting in silicon.** Philpot, S.R. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439 (US)); Lutsko, J.F.; Wolf, D.; Yip, S. *Physical Review [Section] B: Condensed Matter (USA),* 40(5): 2831-2840 (15 Aug 1989). DOE Contract W-31-109-ENG-38.

The high-temperature behavior of both a high-angle twist grain boundary and a free surface on the (110) plane of silicon are investigated using molecular dynamics and the Stillinger-Weber potential. It is found that, above the thermodynamic melting point, melting is nucleated at the grain boundary or surface and propagates through the system with a velocity that increases with temperature. We conclude that, due to the relatively fast nucleation times, melting in real crystals should be initiated at grain boundaries and surfaces, a conclusion that is entirely in accord with experiment.

52694 **Photon-stimulated desorption of fluorine from silicon via substrate core excitations.** Yarmoff, J.A. (Surface Science Division, National Institute of Standards and Technology, Gaithersburg, Maryland 20899 (US)); Joyce, S.A. *Physical Review [Section] B: Condensed Matter (USA),* 40(5): 3143-3150 (15 Aug 1989).

Photon-stimulated desorption (PSD) of F^+ was performed for silicon (111) surfaces terminated with fluorine atoms. The surfaces were prepared by exposure of clean silicon to XeF_2. The onset for PSD at the Si 2*p* edge correlated with the transition from the 2*p* level of the bonding silicon atom to the conduction-band minimum, and was thus a function of the oxidation state of the bonding atom. The ions originating from a SiF surface species desorbed along the surface normal while the ions from a SiF_3 group desorbed in off-normal directions. Localized 3*s* and 3*p* Rydberg-like resonances were observed in the quasimolecular SiF_3 moieties. The ion kinetic-energy distributions were measured as an aid to elucidating the desorption mechanism. Measurements of the PSD of F^+ at the Si

2*s* edge were used to confirm the 3*s* and 3*p* character of the measured resonances.

52695 Evaluation of quasiparticle energies for semiconductors without inversion symmetry. Zhang, S.B. (Department of Physics, University of California, Berkeley, California 94720 (US)); Tomanek, D.; Cohen, M.L.; Louie, S.G.; Hybertsen, M.S. *Physical Review [Section] B: Condensed Matter (USA),* 40(5): 3162-3168 (15 Aug 1989). DOE Contract AC03-76SF00098.

We have generalized the Fourier-space Hybertsen-Louie self-energy approach for quasiparticle energies in semiconductors to cases without inversion symmetry. In the evaluation of the self-energy operator, a complex four-dimensional Fourier space is used to carry out the double Fourier transforms for time and spatial variables independently. The generalized plasmon-pole scheme for including both local fields and dynamical effects is also properly extended to systems without an inversion center. The quasiparticle energies for GaAs and AlAs are calculated with use of this approach and results in agreement with experimental data are obtained.

52696 Defects and mass transport in rutile-structured fluorides. I. Experiment. Ling, S. (Henry Krumb School of Mines, Columbia University, New York, New York 10027 (US)); Nowick, A.S. *Physical Review [Section] B: Condensed Matter (USA),* 40(5): 3266-3277 (15 Aug 1989).

A study of low-temperature dielectric relaxation of Er^{3+}- and Y^{3+}-doped MnF_2 crystals in orientations both parallel and perpendicular to the tetragonal *c* axis shows the presence of relaxation peaks with very low activation energies *E*. Specifically, for both dopants, a prominent peak is found in parallel-oriented samples with $E \sim 6$ meV and in perpendicular orientation with $E=37$ meV for Er^{3+} and $E=46$ meV for Y^{3+} doping. Such low *E* values are probably too small to be controlled by lattice migration of a defect. With the aid of computer-simulation calculations, these peaks were interpreted as resulting from a stable low-symmetry configuration of a dopant-F_i pair (F_i is the fluorine-ion interstitial), which allows dipole reorientation by motions involving small fractions of lattice distances. It is then concluded that the intrinsic defect in this crystal is of the anion Frenkel, and not the Schottky, type, as had been proposed earlier. Electrical-conductivity measurements on pure and doped MnF_2 were then interpreted in terms of this defect model to obtain $H_f=3.56\pm0.02$ eV for the formation enthalpy of the anion Frenkel defect, $H_m=0.10$ eV for the migration enthalpy of the F_i, and $H_A=1.1$ eV for the dopant-F_i association enthalpy. The results agree well with the computer-simulation calculations given in the following paper.

52697 Electronic structures of polyethylene and polytetrafluoroethylene. Springborg, M. (Nordisk Institut for Teoretisk Atomfysik (NORDITA), Blegdamsvej 17, DK-2100 Kobenhavn O, Denmark (US)); Lev, M. *Physical Review [Section] B: Condensed Matter (USA),* 40(5): 3333-3339 (15 Aug 1989).

Results of first-principles calculations on polyethylene [poly-(CH_2)] and polytetrafluoroethylene [poly-(CF_2)] are reported. We have optimized the carbon-carbon bond lengths for polyethylene, and using the optimized value we have considered structures in which the carbon backbone is assumed helical both for polyethylene and for polytetrafluoroethylene. The calculated bond lengths and valence-band structures are compared with those of other theoretical approaches and with experimental data. It is finally discussed why polyethylene has a planar carbon backbone whereas polytetrafluoroethylene is nonplanar.

52698 Elastic screening of surface vibrations: Surface phonons on As:Si(111)(1×1). Morse, D.C. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104 (US)); Mele, E.J. *Physical Review [Section] B: Condensed Matter (USA),* 40(5): 3465-3468 (15 Aug 1989).

We analyze the surface-phonon spectrum of As:Si(111)(1×1), modeling the system as a single atomic As monolayer bound to a Si substrate, where the substrate is treated as a semi-infinite elastic continuum. The As surface atoms are treated as local oscillators, with oscillator parameters for the As-Si bonding calculated from self-consistent local-density-functional calculations of the total surface energy. The results are in semiquantitative agreement with recent helium scattering measurements of surface phonons on As:Si(111), and indicate the importance of substrate dynamics in determining the dispersion of the surface modes. In particular, our analysis suggests that the observed phonons can be interpreted most simply as surface mass-defect modes of an elastic substrate.

52699 Degenerate doping and conduction-band properties of Si studied by synchrotron photoemission of Sb/Si(001). Rich, D.H. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, 1110 West Green Street, Urbana, Illinois 61801 (US)); Samsavar, A.; Miller, T.; Leibsle, F.M.; Chiang, T. *Physical Review [Section] B: Condensed Matter (USA),* 40(5): 3469-3472 (15 Aug 1989). DOE Contract AC02-76ER01198.

Photoemission of the Sb-covered Si(001) surface showed that the Fermi-level position crosses the conduction-band minimum of Si for Sb coverages approaching a 1-monolayer saturation limit. Momentum-resolved photoemission of the Sb-saturated Si(001) surface revealed the existence of an occupied initial state located near the conduction-band minimum. The metallic character of the surface is shown to be indicative of degenerate doping in the near-surface region.

52700 Extended norm-conserving pseudopotentials. Shirley, E.L. (Department of Physics and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801 (US)); Allan, D.C.; Martin, R.M.; Joannopoulos, J.D. *Physical Review [Section] B: Condensed Matter (USA),* 40(6): 3652-3660 (15 Aug 1989). DOE Contract AC02-76ER01198.

Atomic pseudopotentials simplify electronic calculations by eliminating atomic core levels and the potentials that bind them. Outside some core radius, norm-conserving pseudopotentials produce the same scattering properties (radial logarithmic derivatives of wave functions for angular momenta of interest) as full-atomic potentials to zeroth and first order in energy about valence-level eigenvalues. We extend the correctness of the radial logarithmic derivative one order further in energy and present analytic and numerical results showing that this extension improves higher-order energy derivatives as well. We also show how our change improves predictions of excited single-particle eigenvalues in a wide variety of atoms, as well as high-energy scattering properties, with effects visible in a band-structure calculation. Our potentials converge nearly as quickly in reciprocal space as the Vanderbilt (modified Hamann-Schlüter-Chiang) potentials from which they are derived, and are easily generated.

52701 Differentiation of electron-paramagnetic-resonance signals of arsenic antisite defects in GaAs. Hoinkis, M. (Center for Advanced Materials, Lawrence Berkeley Laboratory, and Department of Materials Science, University of California, Berkeley, California 94720 (US)); Weber, E.R. *Physical Review [Section] B: Condensed Matter (USA),* 40(6): 3872-3877 (15 Aug 1989). DOE Contract AC03-76SF00098.

Temperature-dependence studies of GaAs electron-paramagnetic-resonance (EPR) quadruplet signals ascribed to arsenic antisite-related (As_{Ga}^+) defects are reported. Observations were made before and after white-light illumination in as-grown, thermally treated, plastically deformed, and neutron-irradiated GaAs. Results show that there is a class of similar As_{Ga}^+-related defects that differ in the local stress fields they experience. Their corresponding EPR quadruplet spin-lattice-relaxation time decreases as local stress increases. The photoquenching property of As_{Ga}^+-related defects can be suppressed by high local stress fields. Furthermore, it is shown that *EL2* is an As_{Ga}^+-related defect which is in the lowest stress field of this class of defects.

52702 Intensities of electronic Raman scattering between crystal-field levels of Ce^{3+} in $LuPO_4$: Nonresonant and near-resonant excitation. Williams, G.M. (Department of Physics, University of California, Berkeley, California 94720 (US)); Becker, P.C.; Conway, J.G.; Edelstein, N.; Boatner, L.A.; Abraham, M.M. *Physical Review [Section] B: Condensed Matter (USA),* 40(6): 4132-4142 (15 Aug 1989). DOE Contract AC05-84OR21400.

The relative intensities of the electronic Raman scattering between individual crystal-field states of the $4f^1$ configuration of Ce^{3+} in $LuPO_4$ are compared to those calculated with use of the standard second-order theory, and also by explicitly evaluating the sum over the virtual intermediate states using the crystal-field wave functions and observed energies of the $5d^1$ configuration. The results

show that the explicit calculation predicts the observed relative intensities much more accurately than the standard theory. In addition, a change in the incident laser energy from the argon-ion green line (514.5 nm) to that of the frequency-tripled output of a Nd^{3+}:YAG (355 nm) laser results in enhancements of the electronic Raman scattering intensities by factors on the order of 100. These enhancements are accurately predicted by the explicit calculation.

52703 **Anomalously small 4*f*-5*d* oscillator strengths and 4*f*-4*f* electronic Raman scattering cross sections for Ce^{3+} in crystals of $LuPO_4$.** Williams, G.M. (Department of Physics, University of California, Berkeley, California 94720 (US)); Edelstein, N.; Boatner, L.A.; Abraham, M.M. *Physical Review [Section] B: Condensed Matter (USA)*, 40(6): 4143-4152 (15 Aug 1989). DOE Contract AC03-76SF00098.

The oscillator strengths for the $4f^1 \rightarrow 5d^1$ transitions of Ce^{3+} in $LuPO_4$ were measured from absorption spectra and compared to calculated values. The measured oscillator strengths were found to be between 2.5 and 20 times smaller than the corresponding theoretical values. In addition, absolute cross sections for electronic Raman scattering between the levels of the $4f^1$ configuration of Ce^{3+} in $LuPO_4$ were measured and found to be significantly smaller than those expected from theory. Both of these discrepancies may be explained by a reduction in the radial integral, $\langle 4f|r|5d\rangle$, for Ce^{3+} in the solid state. Absorption data obtained from the literature for the $4f^1 \rightarrow 5d^1$ transitions of Ce^{3+} in a number of host crystals were used to establish a correlation between the cerium-ion–ligand distance and the reduction in the $\langle 4f|r|5d\rangle$ integral. Effects on electronic Raman scattering cross sections for rare-earth ions in crystals are discussed.

52704 **Carbon *K*-shell near-edge structure: Multiple scattering and band-theory calculations.** Weng, X. (Center for Solid State Science, Arizona State University, Tempe, Arizona 85287-1704 (US)); Rez, P.; Ma, H. *Physical Review [Section] B: Condensed Matter (USA)*, 40(6): 4175-4178 (15 Aug 1989).

The carbon *K*-shell near-edge absorption fine structure of both diamond and graphite has been calculated by the multiple-scattering method and by a single-particle self-consistent pseudo-atomic-orbital band-theory method. We compare the results of these two calculations with experiment, and show that they both give agreement with the experimental near-edge structure.

52705 **X-ray standing-wave analysis with high reflection order and near-normal incidence.** Huang, K. (Physics Department, State University of New York, Albany, New York 12222 (US)); Gibson, W.M.; Zegenhagen, J. *Physical Review [Section] B: Condensed Matter (USA)*, 40(6): 4216-4219 (15 Aug 1989).

The x-ray standing-wave technique permits the determination of the Fourier components of distribution functions which describe the position of a particular atomic species with respect to the lattice unit cell of a host crystal. We demonstrate how to access Fourier components of high order using the tunability of the x-ray energy at synchrotron radiation sources. Bragg reflecting at near-normal incidence largely increases the angular range of the Bragg peak which otherwise would be intolerably narrow for the (555) reflections which we used. The potential of the method is demonstrated by determining the vibrational amplitude of Si atoms in perfect Si crystals and of Ni atoms in an epitaxial $NiSi_2$ layer on Si(111).

52706 **Laser-driven fusion etching process.** Ashby, C.I.H.; Brannon, P.J.; Gerardo, J.B. To Dept. of Energy, Washington, DC. USA Patent 4,838,989. 13 Jun 1989. Filed date 25 Aug 1987. Int. Cl. B44C 1/22. vp Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a process for etching a solid ionic substrate comprising: (a) applying a layer of coating material to a surface of the substrate, the coating material capable of reacting with the substrate when the substrate is in molten form, (b) selectively irradiating regions of the substrate surface to melt at least a portion of the substrate and form a fusion reaction product at the irradiated regions, and (c) removing the fusion reaction product and any excess coating material from the surface of the substrate by dissolving the fusion reaction product and the excess coating material with a solvent which does not substantially dissolve the substrate to thereby form an etched pattern in the substrate surface.

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Refer also to citation(s) 52373

52707 (JAERI-M–89-058) **Department of Chemistry, progress report. January 1986 - December 1988.** Japan Atomic Energy Research Inst., Tokyo (Japan). May 1989. 351p. Order Number DE90709980. Available from NTIS (US Sales Only), PC A16/MF A01.

The research activities in Department of Chemistry during the last 3 years from 1986 to 1988 were compiled. The researches and works of Department of Chemistry are mainly those concerned with important basic matters and items which are committed to the further development of the nuclear fuels and materials, to the establishment of the nuclear fuel cycle, and to the acquisition of data for the environmental safety studies. Intensive efforts were also made on chemical analysis service of various fuels and nuclear materials. (author).

4001 Analytical and Separations Chemistry

Refer also to citation(s) 51641, 51669, 52056, 52541, 52645, 52664, 52666, 52668, 52683, 52684, 52898, 52920, 53183, 53196, 53258, 53267, 53268, 53575, 53884

52708 (CONF-891042–Absts.) **Thirty-first ORNL/DOE conference on analytical chemistry in energy technology.** Oak Ridge National Lab., TN (USA). 1989. 77p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 31. ORNL/DOE conference on analytical chemistry in energy technology; Gatlinburg, TN (USA); 10-12 Oct 1989. Order Number DE90001007. Available from NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.

This report contains the abstracts of the papers presented at the thirty-first ORNL/DOE conference on analytical chemistry in energy technology. (JL)

52709 (DOE/ER/13678–31) **A study of micellar-enhanced ultrafiltration: Progress report, March 1, 1989–February 28, 1990.** Scamehorn, J.F.; Christian, S.D. Oklahoma Univ., Norman, OK (USA). Nov 1989. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-87ER13678. Order Number DE90001231. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We started this progress report with a list of publications and presentations in order to avoid the inefficiency and redundancy of repeating the technical detail contained in these papers. A summary of past work will be given, followed by Abstracts from the published papers this year. The publications should be consulted for more details. Colloid-enhanced ultrafiltration methods are a new class of water purification techniques which have been invented and are being patented by our group at the University of Oklahoma. The methods are designed to remove dissolved ions and/or organic molecules from water. Potential applications include industrial and home water purification units, wastewater clean-up, and ship-board water treatment.

52710 (DOE/ER/13833–3) **[Compensation for peak shifts and variable background responses in fluorescence spectroscopy]: Second annual progress report, October 1, 1988–October 1, 1989.** Rutan, S.C. Virginia Commonwealth Univ., Richmond, VA (USA). 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-88ER13833. Order Number DE90001102. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In the past year, we have made significant progress in several areas. Most of our research has focused on improvements in data analysis methodologies for fluorescence spectroscopic detection in thin-layer and high performance liquid chromatographies, although some experiments have extended the applicability of uv-visible detection methods on thin-layer chromatographic plates. One area of research has focused on the development and evaluation of methods for background correction in fluorescence spectroscopy.

52711 (IAEA-AL–019) **Report of the consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna, 5-9**

September 1988. International Atomic Energy Agency, Seibersdorf (Austria). Laboratories. 1989. 204p. (CONF-880912–: 196. American Chemical Society national meeting, Los Angeles, CA (USA), 25-30 Sep 1988). Order Number DE90603824. Available from NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS.

The experience gained from the post Chernobyl activities revealed that there was a need to screen a large number of samples under these post accident situations as well as the need to get information quickly so that decisions about accident response and food control can be made. The participants of the Consultants' Meeting on MEF recommended that the Agency "initiates a co-ordinated research programme (CRP) on collecting and developing, as necessary, rapid methods for measuring radioactivity in food and environmental samples to facilitate international trade, for emergency cases, etc". Interest in the release of radionuclides to the environment, especially to the foodchain, has been heightened by recent nuclear incidents. In the intermediate and late post-accident period, where the interest is in food control rather than evacuation and sheltering, rapid methods would be useful for screening purposes as well as providing timely information and easing overload. Development of new methods would also have application for routine monitoring of environmental samples. The rapid radiochemical and instrumental methods are intended to permit a determination of radionuclides at a concentration of at least one order of magnitude below those specified for food in the WHO publication "Derived Intervention Levels for Radionuclides in Food" and the IAEA publication, "Safety Series 81". The rapid methods could include rapid screening methods for determination of the approximate or gross radionuclide content in samples, very rapid methods for a more reliable determination or rapid methods for a reasonable accurate determination of the radionuclide content. The specifications for each type of method were outlined. It was emphasized that the overall objectives of developing rapid methods should be achieved with the minimum sacrifice in reliability, practicality and economy. Refs, figs and tabs.

52712 (IAEA-AL–019, pp. 67-75) **Determination of Sr-90 in environmental material using an improved rapid method.** Ghods, A. (International Atomic Energy Agency, Seibersdorf (Austria). Laboratories); Veselsky, J.C.; Zhu, S.; Mirna, A.; Schelenz, R. International Atomic Energy Agency, Seibersdorf (Austria). Laboratories. 1989. (CONF-8809405–: Consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna (Austria), 5-9 Sep 1988). In *Report of the consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna, 5-9 September 1988.* Order Number DE90603824. Available from NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS.

A short report on strontium 90, its occurrence in the biosphere and its rapid determination methods is given. Classification of determination methods suitable for various environmental and biological materials is established. Interference due to Y-91 and a method to eliminate the activity of Y-90 and Y-91 is discussed. Tabs.

52713 (IAEA-AL–019, pp. 77-82) **Determination of uranium in environmental samples by fluorimetry.** Veselsky, J.C. (International Atomic Energy Agency, Seibersdorf (Austria). Laboratories); Ghods, A. International Atomic Energy Agency, Seibersdorf (Austria). Laboratories. 1989. (CONF-8809405–: Consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna (Austria), 5-9 Sep 1988). In *Report of the consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna, 5-9 September 1988.* Order Number DE90603824. Available from NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS.

Uranium determination by means of pulsed laser fluorimetry is developed at Seibersdorf laboratory. The detection limit for uranium concentration in some reference minerals is 0.5 μg U/g (conventional fluorimetry) and 0.05 μg U/g (laser fluorimetry). 8 refs, 5 tabs.

52714 (IAEA-AL–019, pp. 21-65) **Determination of some alpha-emitting actinides in sludge originating from a low level radioactivity waste incineration facility.** LaRosa, J. (International Atomic Energy Agency, Seibersdorf (Austria). Laboratories); Matyjek, M.; Ghods, A.; Cooper, E.; Veselsky, J.; Schelenz, R. International Atomic Energy Agency, Seibersdorf (Austria). Laboratories. 1989. (CONF-8809405–: Consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna (Austria), 5-9 Sep 1988). In *Report of the consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna, 5-9 September 1988.* Order Number DE90603824. Available from NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS.

Contaminated sludge material from a low-level radioactive waste incinerator has been analyzed for actinide concentration. The separation processes have been investigated separately for the dried surfactant samples and the sediments in the bottom of the container. Coprecipitation, ion exchange chromatography and electrodeposition have been used to prepare the samples for alpha-spectrometry. Rapid separation-determination methods for actinide determination and specificity of the respective analytical steps are discussed. 6 refs, 11 figs, 5 tabs.

52715 (IAEA-AL–019, pp. 119-128) **Possible approaches for the development of rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples.** Perkins, R.W. (Battelle Pacific Northwest Lab., Richland, WA (USA)). International Atomic Energy Agency, Seibersdorf (Austria). Laboratories. 1989. (CONF-8809405–: Consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna (Austria), 5-9 Sep 1988). In *Report of the consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna, 5-9 September 1988.* Order Number DE90603824. Available from NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS.

Poster presentation. ACTINIDES/mass spectroscopy; RADIONUCLIDE MIGRATION/food; ACTINIDES; CHEMICAL ANALYSIS; RADIOECOLOGICAL CONCENTRATION; FOOD; SEPARATION PROCESSES; X-RAY EMISSION ANALYSIS

52716 (IAEA-AL–019, pp. 151-152) **Rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples.** Klusek, C. (USDOE Environmental Measurements Lab., New York, NY (USA)). International Atomic Energy Agency, Seibersdorf (Austria). Laboratories. 1989. (CONF-8809405–: Consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna (Austria), 5-9 Sep 1988). In *Report of the consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna, 5-9 September 1988.* Order Number DE90603824. Available from NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS.

Short communication. LABORATORIES/monitoring; RADIOISOTOPES/separation processes; ENVIRONMENTAL MATERIALS; GAMMA SPECTROSCOPY; LABORATORIES; MONITORING; RADIOISOTOPES; RAIN WATER

52717 (IAEA-AL–019, pp. 143-150) **Rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples.** Paakkola, O. (Finnish Centre for Radiation and Nuclear Safety, Helsinki (Finland)). International Atomic Energy Agency, Seibersdorf (Austria). Laboratories. 1989. (CONF-8809405–: Consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna (Austria), 5-9 Sep 1988). In *Report of the consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna, 5-9 September 1988.* Order Number DE90603824. Available from NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS.

Short communication. 4 figs, 1 tab. ENVIRONMENTAL MATERIALS/radiochemical analysis; FINLAND/laboratories; LABORATORIES/radiation monitoring; FOOD/radiochemical analysis; FINLAND; LABORATORIES; RADIOISOTOPES; FOOD

52718 (IEN-DQUI-DIQUI-NT–02/80) **Equilibrium and extraction mechanism from monomeric and polimeric species of zirconium in solution. part. 2.** Azevedo, H.L.P. de. Instituto de Engenharia Nuclear, Rio de Janeiro, RJ (Brazil). Div. de Quimica. 1980. 11p. (In Portuguese). Order Number DE90606184. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The mechanism of extraction and the equilibrium of chemical species from Zirconium solutions was studied. The multiple extraction method was used to show the species envolved in the extraction process and qualitative informations was obtained about the equilibrium between extractable species (monomers) and non-extractable species (polymers) in the aqueous phase. (M.J.C.).

52719 (INIS-BR–1625) **Adducts compounds of lanthanides (III) trifluoreacetates and yttrium and the N,N - dimenthylformamide.** Silva, M. das G. da. Sao Paulo Univ., SP (Brazil). Inst. de Quimica. 1983. 113p. (In Portuguese). Order Number DE90606123. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

Some studies on lanthanides, f transition elements, and yttrium are presented. Adducts of lanthanides trifluoroacetates and N,N -dimethylformamide are described. The characterization of complexes from elementar analysis, conductance measurements, X-ray patterns, vibrational, electronics and fluorescence spectra are analysed. (M.J.C.).

52720 (INIS-BR–1636) **Determination of rare earth elements in geological samples by isotope dilution mass spectrometry.** Moraes, N.M.P.; Iyer, S.S.; Sato, K. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). [1989]. 2p. Order Number DE90606185. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Published in summary form only. RARE EARTHS/isotope dilution; RARE EARTHS/mass spectroscopy

52721 (INIS-BR–1638) **Trace element determination in aerosols from the Antarctic peninsula by neutron activation analysis.** Loureiro, A.I.M.; Vasconcellos, M.B.A.; Pereira, E.B. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). [1989]. 2p. Order Number DE90606128. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Published in summary form only. AEROSOLS/activation analysis; ELEMENTS/activation analysis; ELEMENTS/trace amounts; AEROSOLS; ANTARCTICA; ELEMENTS; NEUTRONS

52722 (INIS-BR–1639) **Analysis of brazilian snake venoms by neutron activation analysis.** Saiki, M.; Vasconcellos, M.B.A.; Rogero, J.R. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). [1989]. 2p. Order Number DE90606129. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Published in summary form only. SNAKES/venoms; VENOMS/activation analysis; NEUTRONS; SNAKES; VENOMS

52723 (INIS-BR–1642) **Gallium determination by radiometric stripping analysis (X ray).** Nobrega, A.W. da; Mantovano, J.L.; Araujo, V.P. Instituto de Engenharia Nuclear, Rio de Janeiro, RJ (Brazil). 1989. 1p. (In Portuguese). (CONF-8909241–: 5. Brazilian Meeting on Analytical Chemistry, Salvador (Brazil), 4-6 Sep 1989). Order Number DE90606131. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Published in summary form only. GALLIUM/x-ray fluorescence analysis; GALLIUM

52724 (INIS-BR–1649) **Stripping analysis: an electroanalytical technique or a technique applicable for others sectors of instrumental analysis.** Nobrega, A.W. da. Instituto de Engenharia Nuclear, Rio de Janeiro, RJ (Brazil). 1989. 1p. (CONF-8909241–: 5. Brazilian Meeting on Analytical Chemistry, Salvador (Brazil), 4-6 Sep 1989). Order Number DE90606132. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Published in summary form only. RADIOISOTOPES/alpha spectroscopy; RADIOISOTOPES/chemical analysis; RADIOISOTOPES/x-ray fluorescence analysis; RADIOISOTOPES

52725 (INIS-BR–1652) **Selenium determination in biological material by atomic absorption spectrophotometry in graphite furnace and using vapor generation.** Carvalho Vidal, M. de F. de. Pontificia Univ. Catolica do Rio de Janeiro, RJ (Brazil). Dept. de Quimica. 1984. 80p. (In Portuguese). Order Number DE90606133. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

The applicability of the atomic absorption spectrophotometry to the determination of selenium in biological material using vapor generation and electrothermal atomization in the graphite furnace was investigated. Instrumental parameters and the analytical conditions of the methods were studied. Decomposition methods for the samples were tested, and the combustion in the Wickbold apparatus was chosen. (author).

52726 (INIS-BR–1654) **Intercalated compounds of niobium and tantalum dicalcogenides.** Wypych, F. Pontificia Univ. Catolica do Rio de Janeiro, RJ (Brazil). Dept. de Quimica. 1988. 176p. (In Portuguese). Order Number DE90606174. Available from NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS.

The synthesis of niobium and tantalum lamellar compounds and its intercalated derivatives is described. The intercalated compounds with lithium, with alkaline metal and with metals of the first-row transition are studied, characterized by X-ray diffraction. (C.G.C.).

52727 (INIS-BR–1667) **Electron transfer reactions in some complexes of V^{+2}, Co^{+3} and Eu^{+3}.** Lellis, F.T.P. Sao Paulo Univ., SP (Brazil). Inst. de Quimica. 1983. 153p. (In Portuguese). Order Number DE90606176. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The stability constants β_1, β_2, β_3 for the mono-,bis-and tris-substituted complexes from vanadium (III) ions with the pyridine-2-carboxilate liquid are determined potentiometrically. The tris-substituted complex in aqueous solutions by electronic spectra and reversible cyclic voltammetry using gold electrodes is extensively characterized. In the investigation of electron tranfer kinetics involving mild oxidizing complexes, such as $Co(NH_3)^{3+}{}_6$, $Co(en)^{3+}{}_3$, $Co(en)_2\ gly^{2+}$, Co (histidinate)$^{+}{}_2$, $Ru(NH_3)^{3+}{}_6$ and Eu^{3+} ions, the tris (picolinate) vanadate (III) complex is used. Electron transfer kinetics for the $Eu^{3+/2+}$ couple in terms of a pseudo-first order process is analysed. The results, in terms of a tunneling mechanism, involving a set of similar, nuclear coordinates for the reactants and products, are explained. (M.J.C.).

52728 (INIS-BR–1669) **Preparation and characterization of the adducts between lanthanide methanesulfonates and thioxane oxide.** Castro e Silva, E. de. Sao Paulo Univ., SP (Brazil). Inst. de Quimica. 1983. 174p. (In Portuguese). Order Number DE90606188. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The preparation and characterization of the adduct between lanthanide methanesulphonates and thioxane oxide are presented. The compounds characterization by conductance measurements, X-ray powder patterns, infrared, visible and fluorescence spectra, TG, DTG and DTA curves was made. According to the X-ray patterns, three isomorphous series were obtained: a-La-Gd b-Tb-Dy and c-Ho-Lu, Y. (M.J.C.).

52729 (INIS-BR–1670) **Addition compounds of lanthamide (III) and yttrium (III) hexafluorophosphates and N,N - dimethylformamide.** Braga, L.S.P. Sao Paulo Univ., SP (Brazil). Inst. de Quimica. 1983. 164p. (In Portuguese). Order Number DE90606177. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

Addition compounds of lanthanide (III) and yttrium (III) hexafluorophosphates and N-N-Dimetylformamide are described to characterize the complexes, elemental analysis, melting ranges, molar conductance measurements, X-ray powder patters infrared and Raman spectra, TG and DTA curves, are studied. Information concerning the decomposition of the adducts through the thermogravimetric curves and the differential thermal analysis curves is obtained. (M.J.C.).

52730 (INIS-BR–1678) **Lead-lead isotope method. Application to migmatites and associaded rocks of the region of Sao Jose dos Campos, SP.** Babinski, M. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). 1988. 114p. (In Portuguese). Order Number DE90606138. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

Establishment of chemical and analytical procedures, preparation and purification of reagents and the mounting of a clean laboratory (class 100) for the Pb-Pb isotope dating of whole rock and mineral samples are discussed in this work. Two different methods of dissolution of rock samples and chemical separation of lead using anionic resin were tried in a conventional chemical laboratory using analytical grade reagents. The samples analysed were paleossome and neossome of migmatites from Sao Jose dos Campos, SP, and

from the results obtained the analytical method to be employed was chosen. The results obtained by this method agree well with those of the Geochronology Laboratory at Oxford, for the same samples. Applying the established analytical procedure, migmatites and associated gneisses from the region of Sao Jose dos Campos were dated by Pb/Pb method. Some of the samples were also dated by Rb-Sr method. The lead-lead isochron age of 2355 +- 85 M.a. (μ_1 = 8.33) for the paleossome may be interpreted as the age of the metamorphism for these rocks, which were formed probably during the Archean. The age data for the phacoidal gneisses show a similar geological evolution, whereas the 2414 +- 800 M.A. Pb-Pb isochron age for the protomylonitic gneisses indicates a disturbed Pb-Pb isotope system. The neossome samples define a Pb-Pb isochron age of 1388 +- 290 M.A. (μ1 = 8.15), which may be interpreted as the age of migmatization. The calculated Pb-Pb ages for two alkali feldspars from the migmatites are devoid of any geological significance. The age values obtained by the Rb-Sr isotope system for the neossome and paleossome of the migmatites agree with the Pb/Pb data within experimental errors. However, the study shows that results of the Rb-Sr data alone cannot be interpreted unambiguously with out comparison with data from other isotope systems. (author).

52731 (INIS-BR–1681) **Adducts of between lanthanide (III) trifluoromethanesulfonate and yttrium (III) and tetramethylene sulphoxide ligand.** Assis Araujo, F. de. Sao Paulo Univ., SP (Brazil). Inst. de Quimica. 1983. 101p. (In Portuguese). Order Number DE90606139. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

The synthesis, characterization and spectroscopic properties of lanthanides trifluoromethanesulfonate complexes with tetramethylenesulfoxide (TMSO), are described. The interpretation of X-ray powder patterns show one isomorphous series. (M.J.C.).

52732 (INIS-mf–12004) **Development of alkali halide-optics for high power-IR laser. Final report.** Pohl, L. Merck (E.), Darmstadt (Germany, F.R.). 17 Apr 1989. 21p. (In German). Contract BMFT ATT 2118 D3. Order Number DE90711663. Available from NTIS (US Sales Only), PC A03/MF A01.

In this work 'Development of Alkali Halide-Optics for High Power-IR Laser' we investigated the purification of sodiumchloride-, potassiumchloride- and potassiumbromide-raw materials. We succeeded to reduce the content of impurities like Cu, Pb, V, Cr, Mn, Fe, Co and Ni in these raw materials to the lower of ppb's by a Complex-Adsorption-Method (CAM). Crystals were grown from purified substances by 'Kyropoulos' method'. Windows were cur thereof, polished and measured by FTIR-spectroscopy. Analytical data showed, that the resulting crystals were of lower quality than the raw materials. Because of this fact crystal-growing-conditions have to undergo a special improvement. Alkali halide windows from other sources on the market had been tested. (orig.).

52733 (INIS-mf–12006, pp. 82) **Investigations at the proton microprobe.** Bajt, S.; Kacar, B.; Pernicka, E.; Povh, B.; Scherer, J.; Traxel, K. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Chondrules of the meteorite 'Bjurboele' have been measured for their trace element contents. The detection limit for elements with atomic numbers (z=26-35) was about 5 to 10 ppm for all crystal phases. Contrary to the expectations Zn was found in silicate and not in sulphide phases, with an enhancement towards the border of the chondrules. (orig.).

52734 (INIS-mf–12006, pp. 133-134) **Chemical analysis of interplanetary dust particles using the proton-microprobe and synchrotron-radiation.** Antz, C. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.)); Jessberger, E.K.; Wallenwein, R.; Bavdaz, M.; Bohn, O.; Buttkewitz, A.; Knoechel, A.; Traxel, K. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

A series of chemical analyses of two interplanetary dust particles (IDPs), SP85 and SP87, has been performed with a proton (PIXE)- and a synchrotron-radiation (SYRFA)-microprobe. The quantitative results have been discussed with respect to sample heating and atmospheric contamination. Eleven more samples from the stratospheric collection have been analysed with PIXE and SYRFA. SYRFA appears to be a suitable tool for multielement analyses in the micro range with the advantage of much less irradiation time compared to PIXE. (orig.).

52735 (MAFF-AEPAM–5) **Analytical procedures for the determination of strontium radionuclides in environmental materials. Aquatic environment protection: analytical methods.** Harvey, B.R.; Ibbett, R.D.; Lovett, M.B.; Williams, K.J. Ministry of Agriculture, Fisheries and Food, Lowestoft (UK). Directorate of Fisheries Research. 1989. 33p. Order Number DE90603913. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

As part of its statutory role in the authorisation, monitoring and research relating to radioactive wastes discharged into the aquatic environment, the Aquatic Environment Protection Division of the Directorate of Fisheries Research (DFR), Lowestoft routinely carries out analyses for a substantial number of radionuclides in a wide range of environmental materials. The Ministry of a Agriculture, Fisheries and Food has for many years required information about the concentrations of strontium radionuclides in waters, sediments and biological materials. There are not absolute standard methods for such radiochemical analysis; indeed none are required because methodology is continually developing. A very considerable amount of expertise has been developed in the analysis of radiostrontium at the Laboratory since the late 1950s, when detailed analysis first commenced, and the procedures described in this report have been developed and tested over a long period of time with a view to achieving the highest analytical quality. Full details of the practical, analytical and computational procedures, as currently used, are given in the Appendix. (author).

52736 (WSRC-RP–89-786) **An empirical computer model of the F-Area A-Line nitrogen oxides absorption column (F-8 Column).** Shanahan, K.L.; Peterson, S.F. Westinghouse Savannah River Co., Aiken, SC (USA). Sep 1989. 51p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. Order Number DE90001376. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Large quantities of oxides of nitrogen (NO_x) are routinely emitted from the F-Canyon dissolvers and from the F-Area A-Line denitrators. These gases are routed through a nitrogen oxides absorption column located in the A-Line. This column, referred to as the F-8 Column, removes NO_x from the offgas, streams of the dissolvers and denitrators and generates nitric acid. The nitric acid is recycled to the canyon dissolvers. Because of continually more stringent environmental emission restrictions, control of the F-8 Column has become increasingly more difficult. The Savannah River Site has initiated a project to improve operation and control of the column. The project objectives are to use improved control to produce 50 (weight) percent nitric acid while limiting the instaneous NO_x emission rate to maintain opacity from the F-Area stack to less than 40 percent. The Analytical Development Section (ADS) of the Savannah River Laboratory is supporting the A-Line NO_x Absorption Column Improvement Project by determining how the column is currently performing and recommending ways to meet the project goals. ADS chartered a Task Team to collect and study F-8 Column performance data and to recommend appropriate process control strategies. The Task Team constructed and installed an instrumentation package on the F-8 Column performance data and to recommend appropriate process control strategies. The Task Team constructed and installed an instrumentation package on the F-8 Column which would record normal performance data. Simultaneously, an effort was mounted to construct a computer model of the column which would be used to test candidate process control strategies prior to actual Plant testing. This report describes that model. 3 refs., 18 figs., 1 tab.

52737 **Fast-neutron INAA: Nickel sensitivities and fluence variations at three reactors.** Becker, D.A. *Transactions of the American Nuclear Society (USA),* 56: 193-194 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Nickel is known to be both toxic and carcinogenic, but has also been shown to be nutritionally essential for chicks and rats. The accurate determination of nickel at the trace level, however, is difficult in nutritional-, environmental-, and energy-related matrices. Since the NBS reactor (NBSR) was constructed specifically to provide a highly thermalized neutron environment, use of this reactor for FNAA is limited at best. Therefore, two nearby reactors using light water were also investigated to establish our options with FNAA. These nearby reactors were the University of Maryland reactor (a 250-kW TRIGA reactor, located at College Park, 45 min away) and the University of Virginia reactor (a 2-MW reactor, located at Charlottesville, ≈2 h away.). The University of Virginia reactor had the added advantage of a newly installed cadmium-shielded irradiation facility served by a pneumatic tube. The fast neutron fluence variations were found to be significantly different among the three reactors. The experimental sensitivities for nickel in all three reactors have been measured and related in terms of counts per microgram of nickel for 3-h irradiation, 10-day decay, and 3-h count at 1.05% absolute efficiency for the 810.8-keV peak of ^{58}Co.

52738 **Radiochemical neutron activation analysis: Status in chemical analysis.** de Goeij, J.J.M. *Transactions of the American Nuclear Society (USA),* 56: 194-195 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Neutron activation analysis (NAA) is a powerful technique for determining numerous trace elements in a large variety of samples. The main advantages of NAA are (a) multielement character, (b) low level of determination for a sizeable number of elements, (c) virtual freedom of a blank, (d) generally good selectivity, and (e) absence of interferences due to differences in physical or chemical state. In addition to instrumental NAA, radiochemical NAA (RNAA) is often employed for improvement of the determination limit, accuracy, and/or precision. Radiochemical separations may be performed in various degrees of radiochemical purity, depending of the problem at hand. Since germanium detectors with large active volumes have become available as well as germanium well-type detectors with high geometric efficiency, a noticeable development has progressed in the direction of a combination of minimal post-irradiation chemical efforts with the potentials of germanium gamma spectrometry and computerized data handling, at least in cases in which no ultimate sensitivity is required. Automation has been frequently advocated as an attractive way to solve problems of lengthy and complex radiochemical procedures. In general, it can be said that, whereas instrumental NAA has a strong point in respect to costs and multielement character, RNAA scores high in analytical quality as the main feature. Areas where RNAA remains to play a role in the foreseeable future discussed.

52739 **Compton-suppression gamma counting in the neutron activation analysis measurement of noble metals.** Millard, H.T. Jr. *Transactions of the American Nuclear Society (USA),* 56: 195-196 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Recent interest in studying elemental abundance anomalies associated with the Cretaceous and Tertiary (K-T) boundary in geologic strata has increased the importance of analytical methods for the determination of low levels of iridium and other noble metals. The determination of iridium anomalies that are in the range from 1 to 100 μg/kg (ppb) requires radiochemical separation procedures following neutron activation. Faster and less laborious instrumental neutron activation analysis (NAA) techniques using elaborate Compton-suppression gamma counters are under development. Compton-suppression gamma counting (CSGC) uses anticoincidence shielded Ge(Li) detectors that enhance the signal-to-background ratios for gamma photopeaks situated on high Compton backgrounds. In this method, an anti- or noncoincidence spectrum and a coincidence spectrum are collected simultaneously. Most Compton-suppression counting has been done at low count rates, but neutron-activated samples ordinarily produce much higher count rates. In the work reported in this paper, K-T boundary and adjacent samples were neutron irradiated, the noble metals separated as a group, and the noble metal group separately counted using CSGC. Iridium, gold, platinum, and silver were determined. The counting data from these analyses were available for a thorough evaluation of the value of CSGC to the determination of this particular suite of noble metals in geologic samples.

52740 **Evaluation of gamma lines for NAA.** James, W.D. (Texas A & M Univ., College Station (USA)); Boothe, P.N. *Transactions of the American Nuclear Society (USA),* 56: 196-197 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Gamma rays that are emitted from neutron-irradiated materials can be correlated with their radionuclide parent through determination of their energies and observation of their apparent decay periods. As the resolution capabilities of modern gamma spectrometers have greatly increased over the years and as sophisticated computer spectral analysis has become very common, routine evaluation of decay parameters other than gamma energy has become almost obsolete. In a recent study, while carefully optimizing analytical methods, the authors noted specific gamma lines that are routinely used in activation analysis for quantitation to provide excessive variation in analytical results for differing sample matrices. In an effort to identify the possible interferences and to verify the association of other useful gammas to their expected parents, an extensive half-life study was initiated. In this original half-life study, which has now been expanded to the present work, five natural materials, including three marine sediments, US National Bureau of Standards standard reference material 1633a fly ash, and US Geological Survey exploration standard GXR-5, were irradiated together and repeatedly counted over a period of ≈1 1/2 yr. A total of 75 peaks were searched for among the half-life spectra. Tabulations of normalized peak areas were evaluated by fitting a linear regression line through the log of the decay curve to determine the apparent half-life.

52741 **Rapid radiochemical neutron activation analysis - status and future.** Fardy, J.J. *Transactions of the American Nuclear Society (USA),* 56: 198-199 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The development of multielement radiochemical separations for neutron activation analysis (NAA) peaked in the mid-1970s with the >100 methods listed in the review of Girardi and Pietra. Since then, however, the number of new published methods has diminished markedly. Ion-exchange chromatography methods dominated the early period, closely followed by solvent extraction, with precipitation and distillation procedures accounting for most of the remainder. This contrasts with the authors review of the literature from 1980 to the present. Solvent extraction, precipitation, and adsorption techniques were evenly divided among the methods listed. The slower ion-exchange technique was reserved for the more difficult separations or where high precision and accuracy were required. Radiochemical NAA developments and applications have diminished as more and more fast instrumental techniques including short time activation analysis have been adopted. Because NAA has no blank problems after irradiation of the sample, however, in contrast to nonnuclear analytical techniques including ICP-MS, it becomes the obvious choice where high sensitivity and low limit of detection are required for trace elements in solid samples. Future developments of NAA will rely mainly on rapid and simple separation techniques whose detection limits are economically competitive. More sophisticated and complex procedures must be restricted to those elements whose presence in materials cannot be detected by conventional techniques.

52742 **Progress in high-speed activation analysis.** Westphal, G.P. *Transactions of the American Nuclear Society (USA),* 56: 199-200 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Based on the spectrometry of isometric transitions with half-lives down to 20 ms, high-speed activation analysis is very attractive because of extremely short sample turnaround times. With the aim of presenting the analyst with a ready-made, high-rate, gamma spectrometry system perfectly suited for high-speed activation analysis, a major manufacturer of multichannel analyzer equipment is already offering the virtual pulse generator counting loss correction system as an essential part of their product line. They might be convinced to build a high-quality gated integrator pulse processor incorporating

new pileup rejector technology to be part of several electron modules specifically designed for real-time correction of counting losses. A prototype of this instrument has been tested at in a set-up including an analog-to digital converter, multichannel analyzer, a counting loss correction unit, and spectrum analysis software from the same manufacturer, together with an n-type high-purity germanium detector of 13% relative efficiency with a transistor reset preamplifier from another manufacturer. Based on the described components, a complete turnkey system for high-speed activation analysis performs the tasks of activation, rabbit control, recording of at least four successive counting-loss-corrected spectra, and data analysis within an integrated hardware-software package.

52743 **Applications of INAA with Ghent k_0 factors to the analysis of high-purity metals and ceramics.** Erdtmann, G.; Petri, H.; Kaysser, B.; Kueppers, G. *Transactions of the American Nuclear Society (USA),* 56: 200-201 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Reactor neutron activation analysis (NAA) has been applied for many years in the chemical-analytical service carried out by the Central Division of Chemical Analysis at Kernforschungsanlage Julich. At this research center, two new research programs were started in 1986: high-temperature-resistant materials and structure ceramics, and basic research for information technology. Trace element analyses of materials are required for both programs, and the demand for activation analyses has largely increased. In most cases they are carried out by a purely instrumental technique, and radiochemical NAA is applied but with some special problems. Activation analyses have been carried out for a number of high-purity and ceramic materials, and the paper shows detection limits obtained with some of them. The differences in detection limits depend not only on the types of materials and the levels of impurities but also on the irradiation and counting conditions chose. In order to obtain realistic estimations of the uncertainties of the results, all sources of error have been considered and their influence on total uncertainties calculated via the error propagation law applied to the equation of absolute activation analysis.

52744 **Nuclear characterizations and applications of boron-containing materials.** Mitchell, J.W.; Raghavan, R. *Transactions of the American Nuclear Society (USA),* 56: 201-202 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Materials either doped with traces of boron or containing this element as a matrix component have important technological and research applications. For most applications in technology, semiconductor doping, chemical vapor deposition of glass films, and optical waveguide fiber manufacture, boron levels or distribution must be controlled precisely. Thus, methods for quantitation of boron are needed, and its analytical chemistry still receives considerable study. Several nondestructive nuclear methods are described in this paper that have unique capabilities for quantitative analyses of boron at the trace and macro levels. Excellent high-sensitivity determinations are based on alpha track counting. For micro- and macroanalyses, the nuclear track technique using the $^{10}B(n,\alpha)^{7}$ Li reaction has been applied to map qualitatively the distribution of boron in borosilicate glass and in optical waveguide glass and fibers. Boron in the 1.59 to 7.75% range is determinable in silicate glasses. Similar information has also been obtained by prompt gamma neutron activation. Neuron depth profiling of boron in glass has been performed also. Results for several of these methods are reported.

52745 **Advanced methods for personal-computer-based gamma spectrum analysis.** Aarnio, P.A. (Helsinki Univ. of Technology (Finland)); Routti, J.T. *Transactions of the American Nuclear Society (USA),* 56: 202-204 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

High-resolution gamma spectroscopy with germanium detectors and related computer methods has been in the development process for some 30 yr. The emergence of personal computers (PCs) with remarkable computing power, large working and external memories, fast graphics, and standardized operating systems, allowing easy portability of programs, has made it possible to develop advanced and cost-effective PC-based analysis systems. Emphasis has been on the implementation of mature methods to user-friendly and robust codes. Research interest has turned to automated analysis, rigorous error analysis, and interpretation of results using expert systems and knowledge bases. The problem setting, state-of-the-art practices, and development trends of different phases of analysis are discussed in this paper. This is mostly based on experience with the PC-based MicroSAMPO code, which is a greatly extended derivative of the earlier mainframe SAMPO code.

52746 **A code for the calculation of self-absorption fractions of photons.** Jaegers, P.; Landsberger, S. *Transactions of the American Nuclear Society (USA),* 56: 204-205 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Neutron activation analysis (NAA) is now a well-established technique used by many researchers and commercial companies. It is often wrongly assumed that these NAA methods are matrix independent over a wide variety of samples. Accuracy at the level of a few percent is often difficult to achieve, since components such as timing, pulse pile-up, high dead-time corrections, sample positioning, and chemical separations may severely compromise the results. One area that has received little attention is the calculation of the effect of self-absorption of gamma-rays (including low-energy ones) in samples, particularly those with major components of high-Z values. The analysis of trace components in lead samples is an obvious example, but other high-Z matrices such as various permutations and combinations of zinc, tin, lead, copper, silver, antimony, etc.; ore concentrates; and meteorites are also affected. The authors have developed a simple but effective personal-computer-compatible user-friendly code, however, which can calculate the amount of energy signal that is lost due to the presence of any amount of one or more Z components. The program is based on Dixon's paper of 1951 for the calculation of self-absorption corrections for linear, cylindrical, and spherical sources. To determine the self-absorption fraction of a photon in a source, the FORTRAN computer code SELFABS was written.

52747 **Perturbed angular correlations in relation to chemical analysis.** Bode, P. (Delft Univ. of Technology (Netherlands)); de Btuin, M. *Transactions of the American Nuclear Society (USA),* 56: 205-206 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

For a profound insight into the role of essential and toxic elements, it is important to know the nature and the properties of the chemical forms in which the elements exist. The chemical and physical status of atoms has virtually no or only limited effect on the nuclear decay parameters, and the eventual effects are often small and hard to measure. Still, techniques have been developed in which use is made of nuclear properties sensitive to the chemical status of a radioactive nuclide and the chemical properties of its environment. Examples are Mossbauer spectroscopy, nuclear magnetic resonance spectroscopy, positron annihilation spectroscopy, and the measurement of perturbed angular correlations (PACs). Although most applications of PAC are reported in solid-state chemistry, the technique has also been recognized as highly valuable in studies of macromolecules and biomolecules. For these fields of application, the technique offers the possibilities of in situ and in vivo measurement, experiments in easily disturbed equilibrium systems, and use of low concentrations of the nuclide of interest. In this paper, prospects and limitations of the PAC method used at the Interfaculty Reactor Institute are discussed using examples of applications in biological systems.

52748 **Aluminum analysis in biological reference material by nondestructive methods.** Landsberger, S.; Arendt, A.; Keck, B.; Glascock, M. *Transactions of the American Nuclear Society (USA),* 56: 230-231 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

In recent years, the determination of aluminum in biological materials has become the subject of many research projects. This interest stems from an increasing knowledge of the toxicity of aluminum to both aquatic and human life. Unfortunately, the detection of aluminum in biological materials has proven troublesome. The use of traditional chemical determinations has been shown to be very long and somewhat complicated. Several attempts have been made using neutron activation analysis, but an interfering reaction

must be taken into account. In this experiment the rabbit irradiation facilities at the University of Missouri Research Reactor were used. The aluminum concentrations for eight certified reference materials are shown. When US National Bureau of Standards (NBS) value is given as certified or as an information value, results agree very well. The results for NBS 1572 citrus leaves agree, and NBS 1577 results agree very well with that of Glascock et al.

52749 **Measurement of superconductor stoichiometry by prompt and delayed neutron activation.** Lindstrom, R.M. *Transactions of the American Nuclear Society (USA),* 56: 231 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Compositional analysis provides essential information for understanding the physics of high-temperature superconductors and in developing the production processes that will be required for their industrial application. Knowledge of the stoichiometry of sample materials, especially the oxygen content, is particularly important. Although oxygen is difficult to measure by activation with reactor neutrons, it may be determined by difference if the concentrations of the other elements are known. Prompt and delayed neutron activation analysis has been applied to the measurement of the metals in $YBa_2Cu_3O_7$ superconductors, starting materials, and intermediate products. These measurements show that neutron activation can deliver accurate and timely nondestructive determinations of the stoichiometry of high-temperature superconductor materials.

52750 **Sample handling and chemical procedures for efficacious trace analysis of urine by neutron activation analysis.** Blotcky, A.J.; Rack, E.P.; Roman, F.R. *Transactions of the American Nuclear Society (USA),* 56: 232-233 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Important for the determination of trace elements, ions, or compounds in urine by chemical neutron activation analysis is the optimization of sample handling, preirradiation chemistry, and radioassay procedures necessary for viable analysis. Each element, because of its natural abundance in the earth's crust and, hence, its potential for reagent and environmental contamination, requires specific procedures for storage, handling, and preirradiation chemistry. Radioassay techniques for radionuclides vary depending on their half-lives and decay characteristics. Described in this paper are optimized procedures for aluminum and selenium. While ^{28}Al ($T_{1/2}$ = 2.24 min) and ^{77m}Se($T_{1/2}$ = 17.4s) have short half-lives, their gamma-ray spectra are quite different. Aluminum-28 decays by a 1779-keV gamma and ^{77m}Se by a 162-keV gamma. Unlike selenium, aluminum is a ubiquitous element in the environment requiring special handling to minimize contamination in all phases of its analytical determination.

52751 **The role of neutron activation analysis in nutritional biomonitoring programs.** Iyengar, V. *Transactions of the American Nuclear Society (USA),* 56: 233-234 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Nutritional biomonitoring is a multidisciplinary task and an integral part of a more general bioenvironmental surveillance. In its comprehensive form, it is a combination of biological, environmental, and nutrient monitoring activities. Nutrient monitoring evaluates the input of essential nutrients required to maintain vital bodily functions; this includes vigilance over extreme fluctuations of nutrient intake in relation to the recommended dietary allowances and estimated safe and adequate daily dietary intakes and adherence to the goals of provisional tolerance limits. Environmental monitoring assesses the external human exposure via ambient pathways, namely, air, water, soil, food, etc. Biological monitoring quantifies a toxic agent and its metabolites in representative biologic specimens of an exposed organ to identify health effects. In practice, coordinating all three components of a nutritional biomonitoring program is complex, expensive, and tedious. Experience gained from the US National Health and Nutrition Examination Surveys demonstrates the problems involved. By far the most critical challenge faced here is the question of analytical quality control, particularly when trace element determinations are involved. Yet, measures to ensure reliability of analytical data are mandatory, and there are no short-cuts to this requirement. The purpose of this presentation is to elucidate the potential of neutron activation analysis (NAA) in nutritional biomonitoring activities.

52752 **Studies of generalized elemental imbalances in neurological disease patients using INAA [instrumental neutron activation analysis].** Ehmann, W.D.; Vance, D.E.; Khare, S.S.; Kasarskis, E.J.; Markesbery, W.R. *Transactions of the American Nuclear Society (USA),* 56: 234 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Evidence has been presented in the literature to implicate trace elements in the etiology of several age-related neurological diseases. Most of these studies are based on brain analyses. Using instrumental neutron activation analysis (INAA), we have observed trace element imbalances in brains of patients with Alzheimer's disease, amyotrophic lateral sclerosis (ALS), and Picks's disease. The most prevalent elemental imbalances found in the brain were for bromine, mercury, and the alkali metals. In this study the authors report INAA studies of trace elements in nonneural tissues from Alzheimer's disease and ALS patients. Samples from household relatives were collected for use as controls wherever possible. Hair samples were washed according to the International Atomic Energy Agency recommended procedure. Fingernail samples were scraped with a quartz knife prior to washing by the same procedure. For ALS patients, blood samples were also collected. These data indicate that elemental imbalances in Alzheimer's disease and ALS are not restricted to the brain. Many elements perturbed in the brain are also altered in the several nonneural tissues examined to date. The imbalances in different tissues, however, are not always in the same direction. The changes observed may represent causes, effects, or simply epiphenomena. Longitudinal studies of nonneural tissues and blood, as well as tissue microprobe analyses at the cellular and subcellular level, will be required in order to better assess the role of trace elements in the etiology of these diseases.

52753 **Neutron- and proton-induced reactions for analysis of bioenvironmental samples.** Spyrou, N.M. (Univ. of Surrey (England)); Altaf, W.J.; Khrbish, Y.S. *Transactions of the American Nuclear Society (USA),* 56: 234-235 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The study of the elemental composition of bioenvironmental samples is of continuing interest in a wide variety of medical and environmental investigations, be it as environmental monitors or as indicators of the state of health and disease of an individual or a population. Nuclear activation methods play an important role in these studies as research tools and in certain cases are employed as rapid, routine analytical techniques. Although the authors have been using instrumental neutron activation analysis as the main technique for obtaining information about elemental composition and concentration, they have also developed techniques, for further or complementary analysis, in which proton-induced reactions have been exploited. Two recent studies, in which the composition of human lung tissue and the elemental concentration in plant samples were determined, have been selected as illustrations of the techniques employed.

52754 **Application of neutron activation analysis in the development of anticancer drugs.** Haeberlin, S.T. (Tech Univ. of Munich (Germany, F.R.)); Lux, F.; Schoenenberger, H.; Sprub, Th.; Gust, R. *Transactions of the American Nuclear Society (USA),* 56: 235-236 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Cis-diamminedichloroplatinum(II) (Cisplatin, CDDP), one of the most important cytostatic agents, has only a small tumor-inhibiting effect on hormone-dependent mammary carcinoma (MC). 1,2-bis(2,6-dichloro-4-hydroxyphenyl)ethylenediamine (L)is estrogen receptor (ER) affinic. It was supposed that CDDP derivatives that contain L as ligand would be enriched in the nuclei of ER-rich (ER^+) cancer cells (e.g., ER^+ MC cells) by the receptor system and that such enrichment would cause a good cytostatic effect due to the platinum. Neutron activation analysis (NAA) was applied to provide information on (a) the distribution of the drug in the organism (mice and rats) and (b) changes of the trace element balance under the influence of the therapy.

52755 **Compartmentalization of trace elements in guinea pig tissues by INAA [instrumental neutron activation analysis] and AAS [atomic absorption spectroscopy].** Chatt, A.; Holzbecher, J.; Katz, S.A. *Transactions of the American Nuclear Society (USA),* 56: 236-237 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Human scalp hair analysis has received considerable attention from a variety of disciplines over the last 20 yr or so. Trace element levels of hair have been used in environmental, epidemiological, forensic, nutritional, predictive, and preventive medicine studies. There still exist confusion, skepticism, and controversy, however, among the experts as well as lay persons in the interpretation of hair trace element data. Much of the criticism stems from the lack of quantitative and reliable data on the ability of hair to accurately reflect dose-response relationships. To better define the significance or hair trace element levels (under the auspices of the International Atomic Energy Agency), the authors have undertaken a controlled set of animal experiments in which trace element levels in hair and other tissues have been measured after a mild state of systemic intoxication by chronic, low-does exposure to cadmium and selenium. Instrumental neutron activation analysis (INAA) and atomic absorption spectroscopy (AAS) methods have been developed for the determination of several elements with a high degree of precision and accuracy.

52756 **NAADA: A general-purpose PC-based NAA [neutron activation analysis] routine for the novice researcher.** Domagala, P.; Landsberger, S. *Transactions of the American Nuclear Society (USA),* 56: 205 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Program NAADA is an interactive data analysis routine for the determination of elemental concentrations from raw activation analysis data and existing calibration libraries. NAADA can be run on any IBM-compatible PC with at least 650K RAM. The source code is mixed: MS-FORTRAN and MS-C. The routine is powerful enough to handle large amounts of data, while still maintaining a good degree of user friendliness for the inexperienced NAA researcher. With flexible, PC-based routines, NAA data analysis is more economical, adaptable, and accessible to the general user. This program has proven to be an extremely valuable educational and experimental tool for a wide range of NAA researchers.

52757 **Pollution studies of Saronikos Gulf, Greece, by neutron activation analysis.** Grimanis, A.P. *Transactions of the American Nuclear Society (USA),* 56: 224-225 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Neutron activation analysis (NAA) with its great sensitivity for a large number of elements has been widely used for marine environmental studies Saronikos Gulf receives combined domestic and industrial effluents of the grater Athens area through the Athens sewage outfall (ASO) at Keratsini Bay, which also receives wastes from discrete industrial sources including a fertilizer plant. Such discharges usually contain high concentrations of heavy metals, which can be dangerous to marine ecosystems and humans. This paper is a review of research and monitoring studies of toxic and other trace elements in marine organisms, seawater, and sediments of Saronikos Gulf by NAA performed over the last 15 yr. The objectives of these studies were (a) to find the fates and pathways of toxic and other trace elements, (b) to estimate the extent of pollution, and (c) to pinpoint and distinguish pollution sources.

52758 **Neutron activation analysis of major, minor, and trace elements in marine sediments.** Stone, S.F.; Zeisler, R.; Koster, B.J. *Transactions of the American Nuclear Society (USA),* 56: 228-229 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Neutron activation analysis (NAA) techniques are well established in the multielement assay of geological materials. Similarly, applications of NAA to the analysis of marine sediments have been described. The different emphasis on elemental composition in studying and monitoring the health of the environment, however, presents a new challenge to the analyst. To investigate as many elements as possible, previous multielement procedures need to be reevaluated and modified. In this work, the authors have utilized the NAA steps of a recently developed sequential analysis procedure that obtained concentrations for 45 biological and pollutant elements in marine bivalves. This procedure, with modification, was applied to samples of marine sediments collected for the National Oceanic and Atmospheric Administration (NOAA) National Status and Trends (NS&T) specimen banking program.

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Refer also to citation(s) 51627, 52597, 52642, 52836, 53181

52759 (BNL–42905) **Studies of hypervalent iron.** Bielski, B.H.J. Brookhaven National Lab., Upton, NY (USA). 1989. 18p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8909226–1: 5. conference on superoxide and superoxide dismutase, Jerusalem (Israel), 17-22 Sep 1989). Order Number DE90000529. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The iron (IV), (V) and (VI) oxidation states are of great interest because of their role in catalytic oxidation/hydroxylation reactions. This report summarizes the information currently available on the kinetic and chemical properties of the water-soluble ions of FeO_4^{2-}, FeO_4^{3-} and FeO_4^{4-}, their protonated forms, and/or simple complex derivatives. The discussion includes their radiation-induced formation, decay kinetics, reactivity with other compounds, determination of their respective pK_a values as well as spectral properties. 32 refs., 3 figs., 2 tabs.

52760 (CONF-891013–2) **Use of a surfactant to control interfacial driving forces for single droplet mass transport experiments characteristic of solvent extraction.** Scott, T.C.; Cosgrove, J.M.; DePaoli, D.W.; Sisson, W.G.; Harris, M.T. Oak Ridge National Lab., TN (USA). Oct 1989. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 6. symposium on separation science and technology for energy applications; Knoxville, TN (USA); 22-27 Oct 1989. Order Number DE90001732. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

An industrial surfactant has been added to the water/2-ethyl-1-hexanol (2EH) system in order to effect the interfacial distribution properties of a fluorescent dye. Addition of 0.05 vol % ethomeen S/15 to water-saturated-2EH decreased the distribution coefficient (aqueous/organic) of the dye (acid red 52) from 1100 (no surfactant) to 1. In the dye concentration range of 2.5 to 10 ppM, the distribution coefficient can be adjusted to values between the aforementioned limits by varying the surfactant concentration. Addition of increasing amounts of the surfactant caused the interfacial tension to uniformly decrease from 16.2 dyne/cm (no surfactant) to 13.0 dyne/cm (0.05 vol%). However, laser-light scattering data on the resulting aqueous and organic samples yielded no evidence of any micellar activity. In this limit of low dye concentration, it appears that the enhanced solubilization of the dye in the organic phase can be used to alter the driving force for interfacial mass transfer experiments. 9 refs., 1 tab.

52761 (CONF-891013–3) **Preparative-scale proteins seperations by continuous annular chromatography.** Bloomingburg, G.F.; Bauer, J.S.; Carta, G.; Byers, C.H. Oak Ridge National Lab., TN (USA). 1989. 30p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From 6. symposium on separation science and technology for energy applications; Knoxville, TN (USA); 22-27 Oct 1989. Order Number DE90001954. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The use of continuous annular chromatography (CAC) for the separation of protein mixtures is studied in a preparative-scale CAC unit. S-Sepharose, a strong-acid porous cation exchange resin is used as the separation medium mixtures of albumin, hemoglobin, and cytochrome-C are used as a model separation system. Equilibrium and mass transfer parameter are developed for this system on the basis of fixed-bed chromatograph experiments. A mathematical model is then successfully used in conjunction with these parameters to simulate the performance of the CAC separations. 11 refs., 11 figs., 3 tabs.

52762 (DOE/ER/13653–3) **[Utilization of magnetic effects as a means of isotopic enrichment].** Columbia Univ., New York, NY

(USA). [1989]. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER13653. Order Number DE90001225. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The research supported by Grant DE-FG02-87ER13653 has involved systematic investigations of the magnetic isotope effect, with the goals of enhancing our understanding of the phenomena, of optimizing the efficiency of the magnetic isotope effect in the separation of magnetic isotope from non-magnetic isotopes, and of applying knowledge obtained from these investigations to other areas of importance to the energy sciences, such as interface chemistry.

52763 (DOE/ER/13832–9) **Metal ion complexation by ionizable crown ethers: Progress report, September 1988–August 1989.** Bartsch, R.A. Texas Tech Univ., Lubbock, TX (USA). Dept. of Chemistry and Biochemistry. Sep 1989. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-88ER13832. Order Number DE90001101. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Research conducted since the last progress report includes the synthesis and characterization of twenty three novel proton-ionizable crown ether compounds. Metal ion complexation behavior of new and previously-synthesized proton-ionizable crown ether compounds has been probed by solvent extraction and transport across polymer-supported liquid membranes. The behavior of neutral polyether and proton-ionizable polyether ligands in polymeric membrane electrodes has been assessed. Studies of the use of proton-ionizable crown ethers for separation of lithium isotopes were initiated. Also, the thermodynamics of interactions between alkali metal cations and ionized crown ethers have been probed by titration calorimetry. 10 refs., 1 tab.

52764 (INIS-BR–1666) **Substitution effect in nuclear magnetic resonance of C-13: α methoxicyclohexanones.** Lopez Holland, M.A.G. Sao Paulo Univ., SP (Brazil). Inst. de Quimica. 1984. 123p. (In Portuguese). Order Number DE90605724. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

Eletronic and steric interactions between the carbonyl and methoxyl groups in α-methoxicyclohexanones by H-1 and C-13 nuclear magnetic resonance spectroscopy (n.m.r) is studied. Interpretation of H-1 n.m.r measurements based on the carbonyl group anisotropy is made. The asigment of spectral lines to specific nuclear by Lanthanide Shift Reagent Experiments is confirmed. Interpretation of C-13 n.m.r. spectra with respect to molecular effects and emphirical relationships associated with the substituent was analysed. The C-13 chemical shift asignment by comparison with results of partially (SFORD) and fully decompled spectra and also by relating the measured chemical shift with values cited in the literature for similar compounds are made. A qualitative study using I.R. spectroscopy in attempt to evaluate the predominance of one the conformers of the studied compounds in solutions of n-hexan and chloroform is made. (M.J.C.).

52765 (INIS-BR–1680) **Structural study of pyrones by NMR.** Mandarino, D.G. Sao Paulo Univ., SP (Brazil). Inst. de Quimica. 1985. 196p. (In Portuguese). Order Number DE90605725. Available from NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS.

Extracts of two species of Aniba, designed Aniba-SA (light petroleum extract) and Aniba-SB (benzene extract), afforded by chromatographic fraccionation some compounds. The isolated compounds were identified using spectrometric data and C^{13}-NMR coupled and decompled spectra of pyrones were registered. Measurement of the heteronuclear residual coupling by irradiation proton frequency off-resonance was used for distinguish C-5, C-7 and C-8 carbons of the pyrones SB-1, SB-3, SB-4 and SB-5. (M.J.C.).

52766 (INIS-mf–12006, pp. 46-47) **Preparation of special sputtering material for the accelerator ion source.** Baumann, H. (Frankfurt Univ. (Germany, F.R.). Inst. fuer Kernphysik); Hinderer, S.; Kayser, J.; Sapir, L.; Schuehrer, B.; Wirth, H.L. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

To get a good ion yield from the ion source of the accelerator, special compounds of the isotopic sputter material are requested. So $^{6}Li_2O$ and $^{142}NdF_3$ were prepared. (orig.).

52767 (INIS-SU–122/A, pp. 35-36) **High-temperature raman spectroscopy study of crystallization processes of gallium garnet melts.** Voron'ko, Yu.K. (AN SSSR, Moscow (USSR). Inst. Obshchej Fiziki); Kudryavtsev, A.B.; Sobol', A.A.; Sorokin, E.V. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: Symposium on molecular beam epitaxy; 7. All-Union conference on crystal growth, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. 2 refs.; 2 figs. GALLIUM OXIDES/crystallization; NIOBIUM OXIDES/crystallization; SAMARIUM OXIDES/crystallization; CHEMICAL COMPOSITION; FERRITE GARNETS; CRYSTALLIZATION; KINETICS; MOLECULAR STRUCTURE; MOLTEN SALTS; PHASE DIAGRAMS; QUANTITY RATIO; RAMAN SPECTROSCOPY

52768 (INIS-SU–122/A, pp. 62-63) **On the possibility of growth of garnet structure crystals with desired thermal properties.** Petrunin, G.I. (Moskovskij Gosudarstvennyj Univ., Moscow (USSR)); Timoshechkin, M.I.; Popov, V.G. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. 4 refs.; 2 figs. GALLIUM OXIDES/crystal growth; GALLIUM OXIDES/specific heat; RARE EARTH COMPOUNDS/crystal growth; RARE EARTH COMPOUNDS/specific heat; CHEMICAL COMPOSITION; FERRITE GARNETS; MOLECULAR WEIGHT; THERMAL CONDUCTIVITY

52769 (INIS-SU–122/A, pp. 16-17) **Explosive crystallization of amorphous substances.** Shklovskij, V.A. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.); Kuz'menko, V.M. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. 6 refs. CADMIUM TELLURIDES/crystallization; INDIUM COMPOUNDS/crystallization; VANADIUM/crystallization; YTTERBIUM/crystallization; AMORPHOUS STATE; ANTIMONIDES; CRYSTALLIZATION; FILMS; IMPURITIES; KINETICS; VANADIUM; YTTERBIUM

52770 (INIS-SU–122/A, pp. 64-65) **Numerical modeling of concentration fields in melt during growth of monocrystals of complex oxide compounds with a wide region of homogeneity (gadolinium-gallium garnet as an example).** Ponomarev, N.M. (Gosudarstvennyj Nauchno-Issledovatel'skij i Proektnyj Inst. Redkometallicheskoj Promyshlennosti, Moscow (USSR)); Remizov, I.A. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. 1 ref. CRYSTAL GROWTH/mathematical models; GADOLINIUM OXIDES/crystal growth; GALLIUM OXIDES/crystal growth; CHEMICAL COMPOSITION; CRYSTALLIZATION; CZOCHRALSKI METHOD; FERRITE GARNETS; MONOCRYSTALS; QUANTITY RATIO

52771 (INIS-SU–122/A, pp. 66) **Peculiarities of temperature distribution in gadolinium-gallium garnets of big diameter during their growth by the Czochralski method.** Strelov, V.I. (AN SSSR, Moscow (USSR). Inst. Kristallografii); Man'shin, V.S.; Zakharov, B.G.; Pugachev, V.A. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. GADOLINIUM OXIDES/crystal growth; GALLIUM OXIDES/crystal growth; CZOCHRALSKI METHOD; FERRITE GARNETS; KINETICS; MONOCRYSTALS; TEMPERATURE DISTRIBUTION; VERY HIGH TEMPERATURE

52772 (INIS-SU–122/A, pp. 89-91) **Morphology of crystals of alumo-yttrium garnets, grown from melt by the Czochralski method.** Koren', R.V. (Leningradskij Gornyj Inst., Leningrad (USSR)); Lyubalin, M.D. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. 4 refs.; 2 figs. YTTRIUM OXIDES/crystal growth; YTTRIUM OXIDES/crystal structure; ALUMINIUM OXIDES; CZOCHRALSKI METHOD; FERRITE GARNETS; KINETICS

52773 (INIS-SU–122/A, pp. 128-129) **Calculation of impurity distribution coefficients from liquidus curves binary systems.** Zibrov, I.P. (AN SSSR, Moscow (USSR). Inst. Kristallografii); Lyamina, O.I.; Turkina, T.M.; Tarasova, E.V.; Sobolev, B.P.; Fedorov, P.P. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: Symposium on molecular beam epitaxy; 7. All-Union conference on crystal growth, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. 3 refs.; 1 tab. ALKALINE EARTH METAL COMPOUNDS/crystal growth; ALKALINE EARTH METAL COMPOUNDS/distribution functions; CADMIUM FLUORIDES/crystal growth; CADMIUM FLUORIDES/distribution functions; RARE EARTH COMPOUNDS/crystal growth; RARE EARTH COMPOUNDS/distribution functions; BINARY MIXTURES; IMPURITIES; MONOCRYSTALS; PHASE DIAGRAMS; SOLID SOLUTIONS

52774 (INIS-SU–122/A, pp. 132-133) **Distribution of SrF_2 along $La_{1-x}Sr_xF_{3-x}$ monocrystals ($0.05 \leq x \leq 0.15$) during growth from melt.** Krivandina, E.A. (AN SSSR, Moscow (USSR). Inst. Kristallografii); Lyamina, O.I.; Samokhina, A.A.; Sobolev, B.P. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. 3 refs.; 2 figs. LANTHANUM FLUORIDES/crystal growth; STRONTIUM FLUORIDES/crystal growth; STRONTIUM FLUORIDES/spatial distribution; CHEMICAL COMPOSITION; LENGTH; MONOCRYSTALS; QUANTITY RATIO; SOLID SOLUTIONS

52775 (INIS-SU–122/A, pp. 158-159) **Multicomponent monocrystal fluoride materials (synthesis, structure, properties).** Sobolev, B.P. (AN SSSR, Moscow (USSR). Inst. Kristallografii). AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. 1 fig. ALKALINE EARTH METAL COMPOUNDS/crystal growth; ALKALINE EARTH METAL COMPOUNDS/phase diagrams; CADMIUM FLUORIDES/crystal growth; CADMIUM FLUORIDES/phase diagrams; RARE EARTH COMPOUNDS/crystal growth; RARE EARTH COMPOUNDS/phase diagrams; THORIUM FLUORIDES/crystal growth; THORIUM FLUORIDES/phase diagrams; TRANSITION ELEMENT COMPOUNDS/crystal growth; TRANSITION ELEMENT COMPOUNDS/phase diagrams; URANIUM FLUORIDES/crystal growth; URANIUM FLUORIDES/phase diagrams; CHEMICAL COMPOSITION; CRYSTAL STRUCTURE; CRYSTALLIZATION; MONOCRYSTALS

52776 (INIS-SU–122/A, pp. 166-167) **Growth of big alloyed monocrystals of cadmium thiogallate.** Balandina, A.I.; Isaev, V.A.; Lapteva, D.R.; Popov, V.V. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

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Short note. 1 ref.; 1 fig. CADMIUM SULFIDES/crystal growth; GALLIUM SULFIDES/crystal growth; CHEMICAL COMPOSITION; CRYSTAL DOPING; DISTRIBUTION FUNCTIONS; MONOCRYSTALS; OPTICAL PROPERTIES; PHASE DIAGRAMS; QUANTITY RATIO; SOLID SOLUTIONS

52777 (INIS-SU–122/A, pp. 168) **Preparation and properties of monocrystals $Tl_9B^{5+}C_6^{6+}$ and $TlB^{5+}C_2^{6+}$, where B^{5+}-Sb, Bi, C^{6+}-Se, Te.** Barchij, I.E. (Uzhgorodskij Gosudarstvennyj Univ., Uzhgorod (Ukrainian SSR)); Peresh, E.Yu.; Gorvat, M.I.; Yanochko, N.M. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

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Short note. ANTIMONY TELLURIDES/crystal growth; BISMUTH TELLURIDES/crystal growth; THALLIUM TELLURIDES/crystal growth; CHEMICAL COMPOSITION; CRYSTAL STRUCTURE; MELTING POINTS; MICROHARDNESS; MONOCRYSTALS; PHASE STUDIES; SOLID SOLUTIONS

52778 (INIS-SU–122/A, pp. 169-170) **Growth processes, crystal structure and stability of properties of $Cd_xMn_yHg_{1-x-y}Te$ monocrystals ($0 \leq x \leq 0.4$; $0 \leq y \leq 0.2$).** Belotskij, D.P. (Chernovitskij Gosudarstvennyj Univ., Chernovtsy (Ukrainian SSR)); Gorbatyuk, I.N.; Pustyl'nik, O.D.; Shafranyuk, V.P.; Kalenik, V.I.; Rusenko, A.V.; Bodnark, O.A.; Kapenko, I.M. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

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Short note. 2 refs. CADMIUM TELLURIDES/crystal growth; CADMIUM TELLURIDES/crystal structure; MANGANESE TELLURIDES/crystal growth; MANGANESE TELLURIDES/crystal structure; MERCURY TELLURIDES/crystal growth; MERCURY TELLURIDES/

crystal structure; CHEMICAL COMPOSITION; CRYSTALLIZATION; MONOCRYSTALS; SEMICONDUCTOR MATERIALS; STABILITY

52779 (INIS-SU–122/A, pp. 173) **Preparation and some properties of monocrystals of solid solutions of $A^{2+}B^{6+}$ compounds.** Bulnyj, M.F. (Chernovitskij Gosudarstvennyj Univ., Chernovtsy (Ukrainian SSR)); Andreev, A.A.; Mozharovskij, L.A.; Kodzhespirov, F.F. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.
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Short note. CADMIUM SULFIDES/crystal growth; CADMIUM SULFIDES/luminescence; LUMINESCENCE; CHEMICAL COMPOSITION; CRYSTAL STRUCTURE; DENSITY; LATTICE PARAMETERS; MELTING POINTS; MONOCRYSTALS; SOLID SOLUTIONS; VERY HIGH TEMPERATURE; ZINC SULFIDES

52780 (INIS-SU–122/A, pp. 178-179) **Reculiarities of indium antimonide monocrystal growth in vertical magnetic field.** Gorbunov, L.A. (AN Latvijskoj SSR, Riga (USSR). Inst. Fiziki); Zemskov, V.S.; Raukhman, M.R.; Viryasova, T.B. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.
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Short note. 1 fig. INDIUM COMPOUNDS/crystal growth; ANTIMONIDES; CRYSTALLIZATION; CZOCHRALSKI METHOD; HIGH TEMPERATURE; MAGNETIC FIELDS; MONOCRYSTALS; TEMPERATURE DISTRIBUTION

52781 (INIS-SU–122/A, pp. 182-183) **Preparation of ideal cadmium telluride crystals by oriented crystallization of melt.** Ivanov, Yu.M. (Moskovskij Inst. Stali i Splavov, Moscow (USSR)); Kostava, N.I.; Fodchuk, I.M. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.
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Short note. 2 refs.; 1 fig. CADMIUM TELLURIDES/crystal growth; CRYSTAL STRUCTURE; CRYSTALLIZATION; INFRARED SPECTRA; MOLTEN SALTS; MONOCRYSTALS; OPACITY

52782 (INIS-SU–122/A, pp. 188-189) **Investigation of some properties of melts of compounds of A^2B^6 group.** Kulakov, M.P. (AN SSSR, Chernogolovka (USSR). Inst. Fiziki Tverdogo Tela); Kolesnikov, N.N. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.
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Short note. 2 refs.; 1 tab. CADMIUM SELENIDES/crystallization; CADMIUM SELENIDES/molten salts; CADMIUM SULFIDES/crystallization; CADMIUM SULFIDES/molten salts; CADMIUM TELLURIDES/crystallization; CADMIUM TELLURIDES/molten salts; MERCURY TELLURIDES/crystallization; MERCURY TELLURIDES/molten salts; ZINC TELLURIDES/crystallization; ZINC TELLURIDES/molten salts; CRYSTALLIZATION; CHEMICAL COMPOSITION; DENSITY; ENTROPY; MELTING; VOLUME

52783 (INIS-SU–122/A, pp. 214-215) **Monocrystal growth of solid solutions on the basis of zirconium dioxide alloyed with titanium.** Aleksandrov, V.I. (AN SSSR, Moscow (USSR). Inst. Obshchej Fiziki); Vojtsitskij, V.P.; Vishnyakova, M.A.; Lomonova, E.E.; Myzina, V.A.; Osiko, V.V. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.
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Short note. 1 ref. YTTRIUM OXIDES/crystal growth; ZIRCONIUM OXIDES/crystal growth; IMPURITIES; INCLUSIONS; KINETICS; MONOCRYSTALS; QUANTITY RATIO; SOLID SOLUTIONS; SPATIAL DISTRIBUTION; TITANIUM OXIDES

52784 (INIS-SU–122/A, pp. 245-247) **Growth of chrysoberyl monocrystals activated with chromium and titanium by the method of oriented horizontal crystallization.** Gurov, V.V. (AN SSSR, Novosibirsk (USSR). Inst. Geologii i Geofiziki); Vukin, G.V.; Yurkin, A.M.; Kovalenko, N.V. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.
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Short note. 1 ref.; 2 figs. ALUMINIUM OXIDES/crystal growth; BERYLLIUM OXIDES/crystal growth; CHROMIUM OXIDES; CONTROLLED ATMOSPHERES; CRYSTAL DOPING; CRYSTALLIZATION; HYDROGEN; INCLUSIONS; KINETICS; ORIENTATION; SPATIAL DISTRIBUTION; TITANIUM OXIDES

52785 (INIS-SU–122/A, pp. 275-276) **Synthesis and growth of monocrystals of sodium bismuth tungstate and lithium bismuth molybdate from melt.** Khokhlov, A. (AN Tadzhikskoj SSR, Dushanbe (USSR). Fiziko-Tekhnicheskij Inst.); Klevtsov, P.V.; Khafizov, S.Kh. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.
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Short note. 4 refs. BISMUTH TUNGSTATES/chemical preparation; BISMUTH TUNGSTATES/crystal growth; MOLYBDATES/chemical preparation; MOLYBDATES/crystal growth; SODIUM TUNGSTATES/chemical preparation; SODIUM TUNGSTATES/crystal growth; ANNEALING; CHEMICAL COMPOSITION; CZOCHRALSKI METHOD; LITHIUM COMPOUNDS; MOLYBDATES; MONOCRYSTALS; ORIENTATION

52786 (INIS-SU–122/A, pp. 204-205) **Growth of cadmium iodide crystals and their optical properties.** Belikovich, B.A. (L'vovskij Gosudarstvennyj Univ., Lvov (Ukrainian SSR)); Gloskovskaya, N.K.; Lyskovich, A.B.; Novosad, S.S.; Turchak, R.M. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.
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Short note. 2 refs. CADMIUM IODIDES/crystal growth; CADMIUM IODIDES/optical properties; CRYSTAL STRUCTURE; IMPURITIES; ORIENTATION; STOCKBARGER METHOD

52787 (INIS-SU–122/A, pp. 208-209) **Preparation and investigation by the NQR method of monocrystals of $M_3{}^1Sb_2(Bi_2)Br_9(J_9)$ compounds.** Kun, S.V.; Boguslavskij, A.A.; Kun, A.V.; Lotfullin, R.Sh.; Lazarev, V.B.; Peresh, E.Yu. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.
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Short note. ANTIMONY IODIDES/crystal growth; BISMUTH IODIDES/crystal growth; CESIUM IODIDES/crystal growth; RUBIDIUM IODIDES/crystal growth; BROMIDES; CHEMICAL COMPOSITION; CRYSTAL-PHASE TRANSFORMATIONS; LOW TEMPERATURE; MEDIUM TEMPERATURE; MONOCRYSTALS; NUCLEAR QUADRUPOLE RESONANCE; SPECTRA

52788 (INIS-SU–122/A, pp. 216-217) **Monocrystal growth of calcium-niobium-gallium garnets by pulling at a crystal seed from cold container.** Aleksandrov, V.I. (AN SSSR, Moscow (USSR). Inst. Obshchej Fiziki); Gerasimova, I.A.; Vishnyakova, M.A. and others. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.
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Short note. 2 refs. CALCIUM OXIDES/crystal growth; GALLIUM OXIDES/crystal growth; NIOBIUM OXIDES/crystal growth; CHEMICAL COMPOSITION; CRYSTAL DEFECTS; FERRITE GARNETS; IMPURITIES; INCLUSIONS; MONOCRYSTALS; SPATIAL DISTRIBUTION

52789 (INIS-SU–122/A, pp. 225-227) **Gadolinium molybdate crystal growth for equipment of signal processing by surface acoustic waves.** Belabaev, K.G.; Sarkisov, V.Kh. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.
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Short note. 2 figs. GADOLINIUM COMPOUNDS/crystal growth; MOLYBDATES/crystal growth; CRACKS; CRYSTAL DEFECTS; CRYSTALLIZATION; DOMAIN STRUCTURE; MOLYBDATES; ORIENTATION

52790 (INIS-SU–122/A, pp. 232-233) **Peculiarities of growth of substituted crystals of $NaBi(Mo_{1-x}E_xO_4)_2$ type.** Burak, Ya.V.; Korobij, Yu.S.; Girnyk, I.S.; Lutsiv-Shumskij, L.F. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.
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Short note. 2 refs.; 1 fig. BISMUTH TUNGSTATES/crystal growth; MOLYBDATES/crystal growth; SODIUM TUNGSTATES/crystal growth; CHEMICAL COMPOSITION; CHROMATES; CZOCHRALSKI METHOD; DENSITY; KINETICS; MOLYBDATES; MONOCRYSTALS; QUANTITY RATIO

52791 (INIS-SU–122/A, pp. 234-236) **Peculiarities of crystal growth process of complex oxide compounds.** Burachas, S.F.; Timan, B.L.; Bondar', V.G.; Gorishnij, Yu.V.; Krivoshein, V.I. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.
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Short note. 1 ref.; 1 fig. CADMIUM TUNGSTATES/crystal growth; CZOCHRALSKI METHOD; HEATING; INCLUSIONS; KINETICS

52792 (INIS-SU–122/A, pp. 237-238) **Double alloying and photoinduced properties of lithium niobate crystals.** Vartanyan, Eh.S. (AN Armyanskoj SSR, Erevan (USSR). Inst. Fizicheskikh Issledovanij); Ovsepyan, R.K.; Pogosyan, A.R. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.
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Short note. 3 refs. NIOBATES/crystal doping; NIOBATES/crystal growth; CHEMICAL COMPOSITION; LITHIUM COMPOUNDS; NIOBATES; REFRACTIVITY

52793 (INIS-SU–122/A, pp. 239-240) **Growth and properties of alloyed crystals of BSN and $LiNbO_3$.** Vejspals, A.A. (Latvijskij Gosudarstvennyj Univ., Riga (USSR). Nauchno-Issledovatel'skij Inst. Fiziki Tverdogo Tela); Seglin'sh, Ya.A.; Vajvod, P.A.; Viltsin'sh, V.Ya.; Krasnevskis, A.A. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.
T-14397.
Short note. 1 ref. NIOBATES/crystal growth; NIOBATES/optical properties; STRONTIUM COMPOUNDS/crystal growth; STRONTIUM COMPOUNDS/optical properties; BARIUM COMPOUNDS; CHEMICAL COMPOSITION; CRYSTAL DOPING; CZOCHRALSKI METHOD; KINETICS; LATTICE PARAMETERS; LITHIUM COMPOUNDS; MONOCRYSTALS; NIOBATES; QUANTITY RATIO

52794 (INIS-SU–122/A, pp. 241-242) **Use of microcomputer ISKRA 226 for control of growth process of paratellurite monocrystals.** Vlezko, V.A.; Kokh, A.E. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.
T-14397.
Short note. TELLURIUM COMPOUNDS/crystal growth; CZOCHRALSKI METHOD; MONOCRYSTALS; ON-LINE CONTROL SYSTEMS; OPTIMIZATION; PROCESS COMPUTERS; USES

52795 (INIS-SU–122/A, pp. 243-244) **Crystal growth of ferroelectric $Ba_2LiNb_5O_{15}$.** Gabrielyan, V.T. (AN Armyanskoj SSR, Erevan (USSR). Inst. Fizicheskikh Issledovanij); Kazaryan, L.M.; Rusyan, P.R. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.
T-14397.
Short note. 3 refs. NIOBATES/crystal growth; BARIUM COMPOUNDS; CRYSTAL-PHASE TRANSFORMATIONS; CRYSTALLIZATION; KINETICS; LITHIUM COMPOUNDS; MOLTEN SALTS; NIOBATES; VERY HIGH TEMPERATURE

52796 (INIS-SU–122/A, pp. 248-249) **Monocrystals of gallium garnets with heterovalent substitutions.** Es'kov, N.A. (AN SSSR, Moscow (USSR). Inst. Obshchej Fiziki); Timoshechkin, M.I.; Groshenko, N.A. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. 2 refs.; 1 fig. GADOLINIUM OXIDES/crystal growth; NIOBIUM OXIDES/crystal growth; ZIRCONIUM OXIDES/crystal growth; ALKALINE EARTH METAL COMPOUNDS; CHEMICAL COMPOSITION; CRYSTAL DOPING; FERRITE GARNETS; GALLIUM OXIDES; LATTICE PARAMETERS; MONOCRYSTALS; SOLID SOLUTIONS; VALENCE

52797 (INIS-SU–122/A, pp. 250-251) **Synthesis and investigation of monocrystals of rare earth scandoborates with chantite structure.** Efimenko, V.V.; Ivonina, N.P.; Kutovoj, S.A.; Laptev, V.V.; Lebedev, V.A. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. 3 refs.; 3 figs. BORATES/crystal growth; BORATES/luminescence; RARE EARTH COMPOUNDS/crystal growth; RARE EARTH COMPOUNDS/luminescence; SCANDIUM COMPOUNDS/crystal growth; SCANDIUM COMPOUNDS/luminescence; YTTRIUM COMPOUNDS/crystal growth; YTTRIUM COMPOUNDS/luminescence; BORATES; LUMINESCENCE; CRYSTAL STRUCTURE; LASER CAVITIES; LATTICE PARAMETERS; MONOCRYSTALS; SPECTRA

52798 (INIS-SU–122/A, pp. 252-253) **Growth of laser crystals $CaMoO_4:Nd^{3+}$.** Ivleva, L.I. (AN SSSR, Moscow (USSR). Inst. Obshchej Fiziki); Polozkov, N.M.; Kuz'minov, Yu.S.; Voronov, V.V.; Ivanovskaya, V.M.; Myzina, V.A. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. 2 refs. MOLYBDATES/crystal growth; NEODYMIUM COMPOUNDS/crystal growth; NIOBIUM COMPOUNDS/crystal growth; CALCIUM COMPOUNDS; CRYSTAL DOPING; CZOCHRALSKI METHOD; KINETICS; LASER CAVITIES; MOLYBDATES; QUANTITY RATIO; SPATIAL DISTRIBUTION

52799 (INIS-SU–122/A, pp. 254) **Growth and investigation of germanate $LINbGeO_5$ monocrystals.** Kaminskij, A.A. (AN SSSR, Moscow (USSR). Inst. Kristallografii); Butashin, A.V.; Mill', B.V. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. 1 ref.; 1 fig. NIOBIUM COMPOUNDS/crystal growth; CRYSTAL FIELD; CRYSTAL STRUCTURE; CZOCHRALSKI METHOD; GERMANATES; LITHIUM COMPOUNDS; LUMINESCENCE; MONOCRYSTALS; ORIENTATION; PHASE DIAGRAMS

52800 (INIS-SU–122/A, pp. 257-258) **Growth, physical properties and application of monocrystals of yttrium and scandium oxoorthosilicates.** Korovkin, A.M.; Karpov, V.A.; Merkulyaeva, T.I.; Zhuravleva, Zh.A. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. 3 refs. SCANDIUM SILICATES/crystal growth; YTTRIUM SILICATES/crystal growth; CRYSTAL STRUCTURE; DENSITY; DOPED MATERIALS; HARDNESS; MELTING POINTS; MONOCRYSTALS; OPACITY; RARE EARTH COMPOUNDS; REFRACTIVITY; THERMAL CONDUCTIVITY; THERMAL EXPANSION

52801 (INIS-SU–122/A, pp. 259-260) **Use of molybdenum crucibles and formers during growth of lithium tantalate crystals.** Kurlov, V.N. (AN SSSR, Chernogolovka (USSR). Inst. Fiziki Tverdogo Tela); Red'kin, B.S. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. 3 refs. TANTALATES/crystal growth; CRUCIBLES; CZOCHRALSKI METHOD; DENSITY; KINETICS; LATTICE PARAMETERS; LITHIUM COMPOUNDS; MOLTEN SALTS; MOLYBDENUM; MONOCRYSTALS; OPACITY; TANTALATES; VERY HIGH TEMPERATURE

52802 (INIS-SU–122/A, pp. 261-262) **Increase of thermal stability of rare earth orthoborates with chantite structure.** Laptev, V.V. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. 6 refs. BORATES/crystal growth; RARE EARTH COMPOUNDS/crystal growth; SCANDIUM COMPOUNDS/crystal growth; ALUMINIUM COMPOUNDS; BORATES; CHEMICAL COMPOSITION; CRYSTAL STRUCTURE; CZOCHRALSKI METHOD; GALLIUM COMPOUNDS; MONOCRYSTALS; THERMAL DEGRADATION

52803 (INIS-SU–122/A, pp. 263-264) **Peculiarities of crystal formation of new double molybdates and tungstates.** Mokhosoev, M.V. (AN SSSR, Ulan-Ude (USSR). Inst. Estestvennykh Nauk); Tsyrenova, G.D.; Bazarova, Zh.G.; Khazheeva, Z.I. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. 2 tabs. CADMIUM COMPOUNDS/crystal growth; MOLYBDATES/crystal growth; ZINC TUNGSTATES/crystal growth; ALKALI METAL COMPOUNDS; ALKALINE EARTH METAL COMPOUNDS; CHEMICAL COMPOSITION; CRYSTAL LATTICES; CRYSTAL-PHASE TRANSFORMATIONS; CRYSTALLIZATION; LATTICE PARAMETERS; MOLYBDATES; SPACE GROUPS

52804 (INIS-SU–122/A, pp. 265-267) **Crystal growth of $LINbO_3$:Y with regular domain structure in [011-bar2] direction.** Naumova, I.I. (Moskovskij Gosudarstvennyj Univ., Moscow (USSR)); Tarasenko, V.V.; Yakovleva, G.I.; Aleksandrovskij, A.L. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR,

Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. 3 figs. NIOBATES/crystal growth; YTTRIUM COMPOUNDS/crystal growth; CZOCHRALSKI METHOD; DIFFRACTION; DOMAIN STRUCTURE; DOPED MATERIALS; KINETICS; LITHIUM COMPOUNDS; NIOBATES; ORIENTATION; REFRACTIVITY; TWINNING

52805 (INIS-SU–122/A, pp. 268-269) **Growth of lead molybdate crystals by the Czochralski and the Bridgman-Stockbarger methods.** Nikogosyan, N.S. (AN Armyanskoj SSR, Erevan (USSR). Inst. Fizicheskikh Issledovanij). AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. MOLYBDATES/crystal growth; BRIDGMAN METHOD; COMPARATIVE EVALUATIONS; CRYSTAL DEFECTS; CZOCHRALSKI METHOD; INCLUSIONS; LEAD COMPOUNDS; MOLYBDATES; MONOCRYSTALS; OPTICAL PROPERTIES; STOCKBARGER METHOD

52806 (INIS-SU–122/A, pp. 273-274) **Crystal growth of cerium, praseodymium oxides and their solid solutions from melt.** Filin, Yu.N. (AN SSSR, Leningrad (USSR). Fiziko-Tekhnicheskij Inst.); Melekh, B.T.; Kartenko, N.F.; Shelykh, A.I.; Andreev, A.A.; Smirnov, I.A. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. 2 refs.; 1 tab. CERIUM OXIDES/crystal growth; PRASEODYMIUM OXIDES/crystal growth; BRIDGMAN METHOD; CHEMICAL COMPOSITION; CRYSTALLIZATION; LATTICE PARAMETERS; MONOCRYSTALS; SOLID SOLUTIONS

52807 (INIS-SU–122/A, pp. 277-279) **Growth of rare earth ternary gallates from own melts.** Chemekova, T.Yu. (AN SSSR, Leningrad (USSR). Inst. Khimii Silikatov); Rakhmankulov, R.M.; Valtere, A.Ya.; Appen, Z.S. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. 2 figs. RARE EARTH COMPOUNDS/crystal growth; STRONTIUM OXIDES/crystal growth; CHEMICAL COMPOSITION; CRYSTALLIZATION; CZOCHRALSKI METHOD; EMISSION SPECTRA; GALLIUM OXIDES; KINETICS; LUMINESCENCE; MONOCRYSTALS

52808 (INIS-SU–122/A, pp. 291) **Low-melting laser garnets. Investigation of structure defects.** Voron'ko, Yu.K. (AN SSSR, Moscow (USSR). Inst. Obshchej Fiziki); Es'kov, N.A.; Osiko, V.V.; Prokhorov, A.M.; Sobol', A.A.; Timoshechkin, M.I. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. NIOBIUM OXIDES/crystal defects; CALCIUM OXIDES; FERRITE GARNETS; GALLIUM OXIDES; LASER CAVITIES; MONOCRYSTALS; RAMAN SPECTROSCOPY; SOLID SOLUTIONS

52809 (INIS-SU–122/A, pp. 292-293) **Plastic bending If CsI monocrystals pulled from melt at a crystal seed.** Goriletskij, V.I.; Protsenko, V.G.; Radkevich, A.V.; Sumin, V.I.; Ehjdel'man, L.G. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: Symposium on molecular beam epitaxy, Moscow (USSR), 14 Nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. 2 figs. CESIUM IODIDES/crystal growth; BENDING; MONOCRYSTALS; ORIENTATION

52810 (INIS-SU–122/A, pp. 348-349) **Investigation of real structure of cadmium telluride crystals prepared by different methods.** Savitskij, A.V. (Chernovitskij Gosudarstvennyj Univ., Chernovtsy (Ukrainian SSR)); Shafranyuk, V.P.; Bejsyuk, P.P.; Pavlin, P.A. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. 3 refs. CADMIUM TELLURIDES/crystal growth; CADMIUM TELLURIDES/crystal structure; COMPARATIVE EVALUATIONS; CRYSTAL DOPING; CRYSTALS; DOPED MATERIALS; INCLUSIONS; ORIENTATION

52811 (INIS-SU–122/A, pp. 397-399) **Structure defects in $Sr(GaMgZr)_{12}O_{19}$ monocrystals grown by the Czochralski method.** Kizyaev, O.A.; Ledneva, F.I.; Bol'shakova, G.V.; Ustinov, V.M.; Kleptsyn, V.F. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. 1 ref.; 1 fig. STRONTIUM OXIDES/crystal defects; ZIRCONIUM OXIDES/crystal defects; CRYSTAL GROWTH; CZOCHRALSKI METHOD; GALLIUM OXIDES; HEXAGONAL LATTICES; LATTICE PARAMETERS; MAGNESIUM OXIDES; MONOCRYSTALS; ORIENTATION

52812 (INIS-SU–122/A, pp. 308-309) **Formation of dislocation structure of indium phosphide monocrystals.** Berkova, A.V. (Gosudarstvennyj Nauchno-Issledovatel'skij i Proektnyj Inst. Redkometallicheskoj Promyshlennosti, Moscow (USSR)); Mikryukova, E.V.; Nashel'skij, A.Ya.; Shifrin, S.S.; Yakobson, S.V. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. INDIUM PHOSPHIDES/crystal growth; INDIUM PHOSPHIDES/dislocations; CZOCHRALSKI METHOD; DISLOCATIONS; KINETICS; MONOCRYSTALS

52813 (INIS-SU–122/A, pp. 334-335) **X-ray topographic study of real structure of cadmium telluride monocrytals.** Kizyaev, O.A. (AN SSSR, Moscow (USSR). Inst. Kristallografii); Kutovoj, I.S.; Potolokov, N.A.; Prokhorov, I.A.; Ustinov, V.M.; Zakharov, B.G. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: Symposium on molecular beam epitaxy, Moscow (USSR), 14 Nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. 1 ref. CADMIUM TELLURIDES/crystal growth; CADMIUM TELLURIDES/crystal structure; MANGANESE TELLURIDES/crystal growth; MANGANESE TELLURIDES/crystal structure; ZINC TELLURIDES/crystal growth; ZINC TELLURIDES/crystal structure; CHEMICAL COMPOSITION; MONOCRYSTALS; SOLID SOLUTIONS

52814 (INIS-SU–122/A, pp. 342-343) **Structure peculiarities of cadmium telluride monocrystals.** Krapukhin, V.V.; Kul'chitskaya, T.V.; Dejneko, N.M.; Glebkin, A.A.; Kholina, E.N. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: Symposium on molecular beam epitaxy, Moscow (USSR), 14 Nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. CADMIUM TELLURIDES/crystal growth; CADMIUM TELLURIDES/crystal structure; COMPARATIVE EVALUATIONS; MONOCRYSTALS

52815 (INIS-SU–122/A, pp. 350-351) **Structure of CdS crystals grown from the melt.** Savchenko, I.B. (AN SSSR, Chernogolovka (USSR). Inst. Fiziki Tverdogo Tela); Ivanov, Yu.N. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: Symposium on molecular beam epitaxy, Moscow (USSR), 14 Nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. 1 ref. CADMIUM SULFIDES/crystal growth; CADMIUM SULFIDES/dislocations; BRIDGMAN METHOD; DISLOCATIONS; MONOCRYSTALS; ORIENTATION

52816 (INIS-SU–122/A, pp. 388-390) **Investigation of heterogeneity of phase and chemical composition of $Y_{3-x-y}Ce_xTb_yAl_5O_{12}$ crystals.** Bologova, A.V. (AN SSSR, Moscow (USSR). Inst. Kristallografii); Ryadnov, S.N.; Arzumanyan, G.A.; Ryabchenkov, V.V.; Fedorov, V.A.; Bagdasarov, Kh.S.; Fedorov, E.A. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: Symposium on molecular beam epitaxy, Moscow (USSR), 14 Nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. 3 refs.; 2 figs. CERIUM OXIDES/ferrite garnets; FERRITE GARNETS/chemical composition; FERRITE GARNETS/phase studies; TERBIUM OXIDES/ferrite garnets; YTTRIUM OXIDES/ferrite garnets; ALUMINIUM OXIDES; CRYSTALS; INCLUSIONS; LATTICE PARAMETERS; OPTICAL PROPERTIES; QUANTITY RATIO

52817 (INIS-SU–122/A, pp. 400) **Optical heterogeneity, forming during $CdWO_4$ crystal growth.** Nagornaya, L.L.; Ovechkin, A.E.; Rozenberg, G.Kh.; Matejchenko, P.V.; Vostretsov, Yu.Ya. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: Symposium on molecular beam epitaxy, Moscow (USSR), 14 Nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. CADMIUM TUNGSTATES/crystal growth; CADMIUM TUNGSTATES/opacity; OPACITY; CRYSTAL DEFECTS; CZOCHRALSKI METHOD; IMPURITIES; INCLUSIONS; MONOCRYSTALS; QUANTITY RATIO

52818 (INIS-SU–123) **Solution as electrolytic systems. Interinstitute collection of scientific papers.** Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); Ivanovskij Khimiko-Tekhnologicheskij Inst., Ivanovo (USSR). 1988. 126p. (In Russian). (CONF-8604414–: 7. All-Union Mendeleev's discussion on main modern trends in development of science of solutions, Leningrad (USSR), 10-15 Apr 1986). Order Number DE90705933. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

KE-02327.

Individual papers in scope for the data base are processed separately. (DLC)

52819 (INIS-SU–123, pp. 22-25) **On interference types in electrolyte solutions.** Chernykh, L.V. (Leningradskij Gosudarstvennyj Univ., Leningrad (USSR)); Lilich, L.S. Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); Ivanovskij Khimiko-Tekhnologicheskij Inst., Ivanovo (USSR). 1988. (In Russian). (CONF-8604414–: 7. All-Union Mendeleev's discussion on main modern trends in development of science of solutions, Leningrad (USSR), 10-15 Apr 1986). In *Solutions as electrolytic systems. Interinstitute collection of scientific papers.* Order Number DE90705933. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

KE-02327.

A brief analysis of component interference types in electrolyte aqueous solutions is presented. On the example of studying ClO_4^- ion state in different (lithium, sodium, magnesium, cadmium, europium...) perchlorate solutions using molecular spectroscopy methods it is shown that ion-water interaction essentially depends on counterion nature. For deep understanding of interference processes in solutions with ion-molecular level usefulness of considering the system solubility isotherms is marked. On the example of solubility isotherms of several ternary systems ($PrCl_3$-LiCl-H_2O; $Sc(ClO_4)_3$-$HClO_4$-H_2O; $PrCl_3$-RbCl-H_2O; $CdCl_2$-KCl-H_2O) it is shown that different chemical nature of components results in various dominating interactions (mutual dehydration of electrolytes, dehydration of one of the components etc.). 6 refs.; 4 figs.

52820 (INIS-SU–123, pp. 26-30) **Structure and dynamics of particles in 1-1, 2-1, 3-1 electrolyte aqueous solutions.** Dorosh, A.K. (Ukrainskij Poligraficheskij Inst., L'vov (Ukrainian SSR)); Kostyuchenko, A.Yu.; Skripka, K.I. Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); Ivanovskij Khimiko-Tekhnologicheskij Inst., Ivanovo (USSR). 1988. (In Russian). (CONF-8604414–: 7. All-Union Mendeleev's discussion on main modern trends in development of science of solutions, Leningrad (USSR), 10-15 Apr 1986). In *Solutions as electrolytic systems. Interinstitute collection of scientific papers.* Order Number DE90705933. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

KE-02327.

Direct diffraction methods are used to study structure of aqueous solutions of chlorides and nitrates of alkali, alkaline earth metals, cadmium, manganese, rare earth metals. X-ray scattering intensity curves varying when transiting from one system to another with concentration and temperature variation are presented. Basing on position of small-angle interferential maximum on the curves mean distances between cations in solutions are determined. Mean cation-solvent molecule distance is stated to be practically not varied with the concentration, but it is the less, the stronger is their donor-acceptor interaction. 3 figs.

52821 (INIS-SU–123, pp. 34-37) **Relaxation of surface properties of water and electrolyte aqueous solutions and water ionic equilibrium.** Kochurova, N.N. (Leningradskij Gosudarstvennyj Univ., Leningrad (USSR)). Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); Ivanovskij Khimiko-Tekhnologicheskij Inst., Ivanovo (USSR). 1988. (In Russian). (CONF-8604414–: 7. All-Union Mendeleev's discussion on main modern trends in development of science of solutions,

Leningrad (USSR), 10-15 Apr 1986). In *Solutions as electrolytic systems. Interinstitute collection of scientific papers.* Order Number DE90705933. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

KE-02327.

Study of aging of water jet surface and aqueous solutions of electrolytes is carried out. Relaxation time of dynamic surface tension and electric surface potential of HCl, KOH, NaCl, KCl, CsCl, NaI, KI, $MgCl_2$ et al. aqueous solutions at different concentrations and temperatures is determined. Mechanism of forming surface jet structure of the given liquids is considered. The suggested mechanism of forming binary electric layer in water and aqueous solutions, where water molecule dissociation is significant, anticipates particular role of OH^- and H^+ ions and canuses giant relaxation times of surface layer structure. 23 refs.; 3 figs.

52822 (INIS-SU–123, pp. 38-41) **Role of computerized simulation of physicochemical properties in determination of constituents of multicomponent solutions.** Sal'nikov, Yu.I. (Kazanskij Gosudarstvennyj Univ., Kazan (USSR)); Devyatov, F.V.; Glebov, A.N. Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); Ivanovskij Khimiko-Tekhnologicheskij Inst., Ivanovo (USSR). 1988. (In Russian). (CONF-8604414–: 7. All-Union Mendeleev's discussion on main modern trends in development of science of solutions, Leningrad (USSR), 10-15 Apr 1986). In *Solutions as electrolytic systems. Interinstitute collection of scientific papers.* Order Number DE90705933. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

KE-02327.

Generalized method of formalized simulation of physicochemical properties in different investigation methods (nuclear magnetic relaxation, spectrophotometry, potentiometry, solubility agnetochemistry et al.), which hardware is SPESSP program, is developed. The program permits to computerize equilibrium composition of multicomponent systems at the known values of A_i form formation constants (β_i), general and equilibrium concentrations of independent components (base particles), and also to solve inverse problems with β_i estimation and d_i proportionality factors characteristic of NMR and spectrometry. Combination of NMR method, pH-metry and mathematical modelling permitted to determine complexing equilibrium schemes in Dy(3)-citric acid-water-DMSO (DMFA) system, and also to determine resolvation schemes of formed complexes taking into account coordination data. 9 refs.; 2 tabs.

52823 (INIS-SU–123, pp. 41-72) **Dissolution thermodynamics for non-electrolytes and electrolytes in non-aqueous solvents.** Krestov, G.A. (AN SSSR, Moscow (USSR). Inst. Khimii Nevodnykh Rastvorov). Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); Ivanovskij Khimiko-Tekhnologicheskij Inst., Ivanovo (USSR). 1988. (In Russian). (CONF-8604414–: 7. All-Union Mendeleev's discussion on main modern trends in development of science of solutions, Leningrad (USSR), 10-15 Apr 1986). In *Solutions as electrolytic systems. Interinstitute collection of scientific papers.* Order Number DE90705933. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

KE-02327.

Dependences of dissolution thermodynamic characteristics on the nature of solution components, composition, isotopy and temperature are investigated. On Xe example peculiarities of thermodynamics of noble gas dissolution in monohydric and polyhydric alcohols, in their aqueous solutions and in ethanolic solutions of polyhydric alcohols are considered. Knowledge of thermodynamic characteristics of gas dissolution permits to judge on interparticle interactions and structural peculiarities both of separate and mixed solvents. Data on isotopic effects in solvation enthalpies of hexamethyl phosphotriamide and nitromethane in water and alcohols of different isotopic composition at 278.15 K and 298.15 K are presented. D substitution for H in water and methanol hydroxyl groups causes streangthening of electron-acceptor properties and weakening of electron-donor properties of solvents. Deuterium substitution in alkyl radical has an opposite effect. 24 refs.; 16 figs.; 23 tabs.

52824 (INIS-SU–123, pp. 77-78) **Spectral manifestation of second-sphere interaction with participation of two anions.** Nikol'skij, A.B. (Leningradskij Gosudarstvennyj Univ., Leningrad (USSR)); Kotov, V.Yu. Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); Ivanovskij Khimiko-Tekhnologicheskij Inst., Ivanovo (USSR). 1988. (In Russian). (CONF-8604414–: 7. All-Union Mendeleev's discussion on main modern trends in development of science of solutions, Leningrad (USSR), 10-15 Apr 1986). In *Solutions as electrolytic systems. Interinstitute collection of scientific papers.* Order Number DE90705933. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

KE-02327.

Spectrophotometric method is used to study nitroprusside anion interaction with nucleophilic anion, for instance, I^-. Maximum absorption in electron absorption spectra (EAS) of this system is 315 nm. Dependence of $M^+(Fe(NO)(CN)_5)^{2-}$-I^-system optical density on MI concentration (M-alkali metal) has nonlinear character in the alkali metal iodide low concentration range. The obtained data testify to formation in solutions of ion associates, containing nitroprusside, alkali metal and nucleophilic ions. Products of stability constants of associates and absorption band extinction coefficients in EAS are estimated. These products are 40, 80, 110 and 170 l^3center dotmol^{-3}center dotcm^{-1} for Na^+, K^+, Rb^+ and Cs^+, respectively. 3 refs.

52825 (INIS-SU–123, pp. 101-104) **Spectrophotometric study of nickel (4) complexing with periodate.** Kalinina, V.E. (Ivanovskij Khimiko-Tekhnologicheskij Inst., Ivanovo (USSR)); Kalinin, A.A.; Zhigalova, G.Yu. Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); Ivanovskij Khimiko-Tekhnologicheskij Inst., Ivanovo (USSR). 1988. (In Russian). (CONF-8604414–: 7. All-Union Mendeleev's discussion on main modern trends in development of science of solutions, Leningrad (USSR), 10-15 Apr 1986). In *Solutions as electrolytic systems. Interinstitute collection of scientific papers.* Order Number DE90705933. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

KE-02327.

Spectrophotometric method is used to study complexing in a solution containing K_2SO_4, $NiSO_4$, KOH, $K_2S_2O_8$ potassium periodate at 25.0 deg C. Optical density of solutions was measured at λ=370 nm, pH 8.2 and pH 9.2 (+-0.1). The values of arbitrary stability constant of Ni(4) periodate with 1:1 composition -lgβ_1=3.04 (+-0.15) composition at pH 8.2 and lgβ_1=2.96 (+-0.09) at pH 9.2 are obtained. IR spectra of potassium-nickel (4)-periodate and H_5IO_6 are presented. It is assumed that in aqueos solution nickel complexes (4) are hydroxohydroperiodate ones. 5 refs.; 3 figs.

52826 (INIS-SU–123, pp. 112-114) **Difference of ionic interactions in different structural zones of solution and their manifestation in heterogeneous equilibria.** Lyashchenko, A.K. (AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii); Portnova, S.M.; Borina, A.F. Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); Ivanovskij Khimiko-Tekhnologicheskij Inst., Ivanovo (USSR). 1988. (In Russian). (CONF-8604414–: 7. All-Union Mendeleev's discussion on main modern trends in development of science of solutions, Leningrad (USSR), 10-15 Apr 1986). In *Solutions as electrolytic systems. Interinstitute collection of scientific papers.* Order Number DE90705933. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

KE-02327.

On the basis of own and literary data it is shown that analysis of interparticle interactions in solutions permits to formulate general requlanities of salt solution diagrams in high concentration electrolyte solutions. The conclusions are illustrated with some model systems, including MeHCOO-Me'$(HCOO)_2$-H_2O, where Me-Li, K, Cs; Me'-Co, Ni. 15 refs.; 1 fig.

52827 (INIS-SU–123, pp. 120-125) **Solvation enthalpies of nonpolar molecules and ions in individual solvents.** Korolev, V.P. (AN SSSR, Moscow (USSR). Inst. Khimii Nevodnykh Rastvorov). Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); Ivanovskij Khimiko-Tekhnologicheskij Inst., Ivanovo (USSR). 1988. (In Russian).

(CONF-8604414–: 7. All-Union Mendeleev's discussion on main modern trends in development of science of solutions, Leningrad (USSR), 10-15 Apr 1986). In *Solutions as electrolytic systems. Interinstitute collection of scientific papers.* Order Number DE90705933. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

KE-02327.

Method of studying ionic solvation nature (determination of enthalpies of ion transfer from one solvent to another), taking maximum account of donor-acceptor component of ion-solvent interaction, and in case of solvents associated via H-bonds-their reorganization effects during solvation, is presented. As compared to other methods, maximum difference in cation and anion solvation both in electron-donor and in electron-acceptor solvents is shown. The data obtained for enthalpies of Cs^+ and I^- ion transfer from propylene carbonate to other organic solvents are presented. 20 refs.; 6 figs.; 4 tabs.

52828 (INIS-SU–128) **Physicochemical fundamentals of chemical technology. Issue 150. Proceedings of Institute.** Moskovskij Khimiko-Tekhnologicheskij Inst., Moscow (USSR). 1988. 177p. Order Number DE90705932. Available from NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS.

L-68959.

Individual papers in scope for the data base are processed separately. (DLC)

52829 (INIS-SU–128, pp. 9-11) **Thermochemistry of interaction between zirconium disulfate and sulfuric acid.** Dmitrieva, S.V.; Chekmarev, A.M.; Vorob'ev, A.F. Moskovskij Khimiko-Tekhnologicheskij Inst., Moscow (USSR). 1988. (In Russian). In *Physicochemical fundamentals of chemical technology. Issue 150. Proceedings of Institute.* Order Number DE90705932. Available from NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS.

L-68959.

Thermochemistry of $Zr(SO_4)_2x4H_2O$ (1) interaction with water and sulfuric acid solutions of different concentrations is studied. It is established that the dependence of 1 solution enthalpy on acid concentration 1-bars of a complex polyextreme nature. It is noted that the increase in exothermic nature of dissolving during the increase of H_2SO_4 concentration from 0.05 to 0.50 mol/l is explained by zirconium hydroxosulfate and fulfate complexes substitution for hydroxocomplexes. The endothermal nature of 1 interaction with concentrated (>3 mol/l) H_2SO_4 solutions is conditioned by the formation of acidocomplexes. It is assumed that the abrupt growth of the exothermal nature of 1 interaction with sulfuric acid solutions with the concentration less than 0.05 mol/l with water is connected with colloid formation. 12 refs.; 2 figs.

52830 (INIS-SU–128, pp. 12-14) **Synthesis and properties of thionitrides $Me_4P_6N_{12}S$ (Me-Zn, Cd, Mg).** Ronis, Ya.V. (AN Latvijskoj SSR, Riga (USSR). Inst. Neorganicheskoj Khimii); Vitola, A.A.; Miller, T.N. Moskovskij Khimiko-Tekhnologicheskij Inst., Moscow (USSR). 1988. (In Russian). In *Physicochemical fundamentals of chemical technology. Issue 150. Proceedings of Institute.* Order Number DE90705932. Available from NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS.

L-68959.

Thionitrides $Me_4P_6N_{12}S$ (Me-Zn, Cd, Mg) are prepared for the first time due to the interaction of phosphorus pentasulfide and metal sulfides in ammonia at elevated temperatures. The powder method is used to determine the crystal structure of thionitrides which corresponds to the space group 14-bar3-bar m. For cadmium thionitride the parameter of cubic body-centered lattice is a=0.8473 nm. The structure is built of a three-dimensional phosphorus nitrogenous anion carcass $(P_{12}N_{24})^{12-}$ and metal ions compensate the negative charge of the carcass and two sulfur anions. Thionitrides are the first phosphorus nitrogenous compounds with the structural sodalite type found. 3 refs.; 2 figs.; 1 tab.

52831 (INIS-SU–128, pp. 88-91) **Kinetics of electrosynthesis of persalts on glassy carbon in solutions of carbonates, borates and nitrates.** Khomutov, N.E.; Zakhodyakina, N.A.; Berdyugina, V.P. Moskovskij Khimiko-Tekhnologicheskij Inst., Moscow (USSR). 1988. (In Russian). In *Physicochemical fundamentals of chemical technology. Issue 150. Proceedings of Institute.* Order Number DE90705932. Available from NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS.

L-68959.

The effect of composition, concentration nd stirring intensity, electrolyte pH, electrolysis duration on the kinetics of the anodic process on glassy carbon and on the current output of active oxygen is studied. It is shown that due to its electrochemical characteristics glassy carbon can be used in electrosynthesis of alkali metal persalts, namely sodium perborate. 3 refs.; 2 figs.

52832 (INIS-SU–128, pp. 95-99) **On the kinetics of repassivation of freshly formed zirconium surface.** Nikitin, K.N.; Gubochkin, B.A.; Mushulov, T.P. Moskovskij Khimiko-Tekhnologicheskij Inst., Moscow (USSR). 1988. (In Russian). In *Physicochemical fundamentals of chemical technology. Issue 150. Proceedings of Institute.* Order Number DE90705932. Available from NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS.

L-68959.

The parameters of direct and reverse logarithmic laws of initial oxide film formation on zirconium are determined according to experimentally obtained potential dependences of freshly formed zirconium electrode surface on time. The results are analyzed using the assumption on the existence of competition between the mechanism of simultaneous exchange of places of whole series of oxygen and metal (1) atoms and the mechanism of zolitary ion bounds in vacancies in oxide (2) lattice. The bend on kinetic curves is explained by the transfer from mechanism (1) to mechanism (2) which becomes energetically more profitable in the case of oxide thickness increase. 13 refs.; 3 figs.; 1 tab.

52833 (SAND–89-8009) **Chemkin-II: A Fortran chemical kinetics package for the analysis of gas-phase chemical kinetics.** Kee, R.J.; Rupley, F.M.; Miller, J.A. Sandia National Labs., Livermore, CA (USA). Sep 1989. 127p. Sponsored by U.S. DOE Energy Research. DOE Contract AC04-76DR00789. Order Number DE90000917. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

This document is the user's manual for the second-generation Chemkin package. Chemkin is a software package for whose purpose is to facilitate the formation, solution, and interpretation of problems involving elementary gas-phase chemical kinetics. It provides an especially flexible and powerful tool for incorporating complex chemical kinetics into simulations of fluid dynamics. The package consists of two major software components: an Interpreter and Gas-Phase Subroutine Library. The Interpreter is a program that reads a symbolic description of an elementary, user-specified chemical reaction mechanism. One output from the Interpreter is a data file that forms a link to the Gas-Phase Subroutine Library. This library is a collection of about 100 highly modular Fortran subroutines that may be called to return information on equation of state, thermodynamic properties, and chemical production rates.

52834 (UCID–21757) **Synthesis and characterization of krypton and xenon clathrate complexes.** Sanner, R.D.; Satcher, J.H. Jr. Lawrence Livermore National Lab., CA (USA). 25 Sep 1989. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90000956. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Gradient cooling of aqueous hydroquinone solutions under 25-35 atmospheres of krypton or xenon yields B-hydroquinone/noble gas clathrate complexes having the stoichiometry $[3\ C_6H_4(OH)_2] \cdot M$, where M is the inert gas guest atom. Direct measurement of the entrapped gas was made using a Toepler pump and its identity was verified by mass spectroscopy. The gas retention ability of the clathrate is unaffected by grinding or gentle heating but dissolving or heating the compound to 175°C will release the entrapped gas. These materials provide an extremely efficient way to deliver gases in a solid matrix. 8 refs., 2 figs., 1 tab.

52835 Calculation of the thermodynamic solvent isotope effect for ferrous and ferric ions in water. Kneifel, C.L. (State Univ. of New York, Stony Brook (USA). Dept. of Chemistry); Friedman, H.L.; Newton, M.D. *Zeitschrift fuer Naturforschung, A: Physical Sciences (F.R. Germany)*, 44(5): 385-394 (May 1989). DOE Contract AC02-76CH00016.

Molecular dynamics simulations of molecular models of Fe^{2+} and Fe^{3+} in water (L_2O=H_2O or D_2O) are used to generate various correlation functions that characterize the respective hexaaquo hydration complexes. The static Fe^{2+}-oxygen and Fe^{2+}-hydrogen correlation functions are compared in detail with the first difference neutron diffraction results of Enderby et al. for Ni^{2+}. Velocity autocorrelation functions and corresponding power spectra are generated and analyzed for those modes of hydration shell water molecules whose reduced masses are most sensitive to the changes from H_2O to D_2O. Various approximations are applied to these data to calculate the solvent isotope effect on the difference in hydration free energies for Fe^{2+} and Fe^{3+}. These different approximations all lead to the qualitative conclusion that the net solvent isotope effect reflects a large degree of cacellation between the OL stretching modes and the librational modes. The simulation results generally agree with the results of earlier quantum chemical calculations applied to the same system, but in some respects the new results are not as realistic as the earlier ones. It is proposed that the agreement with experiment would be improved by changes in the model potential which are motivated by other, independent considerations. (orig.).

4005 Photochemistry

Refer also to citation(s) 52673, 53905, 53906

52836 (AD-A-209372/2/XAB) **High-temperature photochemistry kinetics studies of the reactions of H(1(2)s) and D(1(2)S) with N_2O.** Fontijn, A.; Marshall, P.; Ko, T. Rensselaer Polytechnic Inst., Troy, NY (USA). 1989. 7p. Available from NTIS, PC A02/MF A01.

Pub. in Jnl. of Physical Chemistry, Vol. 93, No. 5, 1922-1927(1989).

The H + N_2O and D + N_2O reactions have been investigated by using the high-temperature photochemistry (HTP) technique. Empirical fits to the pressure-independent rate coefficients yield k1(T) = 4.2 x 10 to the -10th to the -14th power exp(-2290 K/T)+ 3.7 x 10 to the -10th power exp (-8430 K/T) and K2 (T) = 3.5x 10 to the 13th power exp -3600 K/T + 5.3 x 10 to the 10th powder exp(9-9170 K/T) cc/molecule/s over the ranges 410-1230 and 450-1210 K, respectively. The pi precision of these results is better than 11% and the 95% accuracy limits are assessed at about + or - 25%. The kinetic isotope effect x(T) = k1(T)/k2(T) decreases from 2.2 at 450 K to 1.3 at 1200 K, behavior contrary to classical transition-state theory which predicts x(T) increasing with temperature. The data are qualitatively consistent with a rate-controlling step that is dominated by tunneling at the lower end of the temperature range.

52837 (DOE/ER/13629-3) **Photoinduced charge separation by polymer-bound chromophores: Progress report, September 1986-October 1989.** Webber, S.E. Texas Univ., Austin, TX (USA). Dept. of Chemistry. Oct 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-86ER13629. Order Number DE90001234. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Most of our work has concentrated on polymethacrylic acid polymers with low mole fractions of covalently attached aromatic chromophore. The electron acceptors have been viologens with different total charge. For all the chromophores except phenanthrene and naphthalene the single state has been studied. For naphthalene and phenanthrene only the triplet state has been studied.

4006 Radiation Chemistry

Refer also to citation(s) 52660, 52743

4007 Radiochemistry and Nuclear Chemistry

Refer also to citation(s) 51860, 52340, 52744, 52746, 52756, 52775, 52991, 53304, 53305, 53306, 53307, 53308, 53309, 53310, 53311, 53312, 53313, 53314

52838 (CONF-8909141-1) **Development of LEU [low enriched uranium] targets for ^{99}Mo production and their chemical processing status, 1989.** Vandegrift, G.F.; Kwok, J.D.; Chamberlain, D.B.; Hoh, J.C.; Streets, E.W.; Vogler, S.; Thresh, H.R.; Domagala, R.F.; Wiencek, T.C.; Matos, J.E. Argonne National Lab., IL (USA). 1989. 14p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From 12. international meeting on reduced enrichment for research and test reactors; Berlin (Germany, F.R.); 10-13 Sep 1989. Order Number DE90001428. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Most of the world's supply of ^{99m}Tc for medical purposes is currently produced from ^{99}Mo derived from the fissioning of high enriched uranium (HEU). Substitution of low enriched uranium (LEU) silicide fuel for the HEU alloy and aluminide fuels used in current target designs will allow equivalent ^{99}Mo yields with no change in target geometries. Substitution of uranium metal for uranium oxide films in other target designs will also allow the substitution of LEU for HEU. Efforts performed in 1989 focused on (1) fabrication of a uranium metal target by Hot Isostatic Pressing uranium metal foil to zirconium, (2) experimental investigation of the dissolution step for U_3Si_2 targets, allowing us to present a conceptual design for the dissolution process and equipment, and (3) investigation of the procedures used to reclaim irradiation uranium from Mo-production targets, allowing us to further analyze the waste and by-product problems associated with the substitution of LEU for HEU. 18 refs., 6 figs., 1 tab.

52839 (INIS-BR-1643) **Preparation of Iodophenin lyophilized reactive set to label with ^{99m}TC used for hepatobyliary study.** Barboza, M.F. de; Herrerias, R.; Muramoto, E.; Colturato, M.T.; Achando, S.S.; Pereira, N.P.S. de; Silva, C.P.G. da. Comissao Nacional de Energia Nuclear, Rio de Janeiro, RJ (Brazil). 1989. 1p. (In Portuguese). Order Number DE90606219. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Published in summary form only. IODINE/synthesis; IODINE/technetium 99; PIVALIC ACID/iodine; PIVALIC ACID/synthesis; PIVALIC ACID/technetium 99; IODINE; SYNTHESIS; LABELLED COMPOUNDS; LYOPHILIZATION; MICE; QUALITY CONTROL

52840 (INIS-BR-1644) **Miniaturized chromatography in routinist radiochemical control of MIBG-^{131}I.** Barboza, M.R.F.F. de; Pereira, N.P.S. de; Silva, C.P.G. da. Comissao Nacional de Energia Nuclear, Rio de Janeiro, RJ (Brazil). 1989. 1p. (In Portuguese). Order Number DE90606220. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Published in summary form only. IODINE 131/chromatography; IODINE 131/radiometric analysis; BRAZILIAN CNEN; CHROMATOGRAPHY

52841 (INIS-BR-1646) **Preparation of Dextran-500-sup (99m)Tc for linfoscintilogography.** Hamada, E.S.; Muramoto, E.; Pereira, N.P.S. de; Herrerias, R.; Silva, C.P.G. da. Comissao Nacional de Energia Nuclear, Rio de Janeiro, RJ (Brazil). 1989. 1p. (In Portuguese). Order Number DE90606222. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Published in summary form only. LYMPHOMAS/dextran; LYMPHOMAS/technetium 99; LYMPHOMAS; DEXTRAN; RADIOPHARMACEUTICALS; SCINTISCANNING

52842 (INIS-BR-1648) **Labelling condition study of gentamicin sulfate with Tc-99m. Biological distribution.** Carvalho, O.G. de; Almeida, M.A.T.M. de. Comissao Nacional de Energia Nuclear, Rio de Janeiro, RJ (Brazil). 1989. 1p. (In Portuguese). Order Number DE90606223. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Published in summary form only. ANTIBIOTICS/labelling; ANTIBIOTICS/technetium 99; ANTIBIOTICS; LABELLING; BIOLOGICAL LOCALIZATION; INTRAVENOUS INJECTION; RADIONUCLIDE KINETICS; RATS

52843 (INIS-BR-1661) **Labelling of gentamicin sulphate with^{99m}Tc.** Carvalho, O.G. de; Almeida, M.A.T.M. Comissao Nacional de Energia Nuclear, Rio de Janeiro, RJ (Brazil). 1986. 6p. (In Portuguese). Order Number DE90606224. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The labelling of gentamicin sulphate with^{99m}Tc and its optimization is shown. The Quality control of gentamicin sulphate -^{99m}Tc, and a study about PH and mass variation of $SnCl_2$ are described. (M.J.C).

52844 (INIS-BR–1665) **Gallium determination with Rodamina B: a simple method.** Queiroz, R.R.U. de. Universidade Estadual de Campinas, SP (Brazil). Inst. de Quimica. 1981. 72p. (In Portuguese). Order Number DE90606225. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

A simple method for determining gallium with Rhodamine B, by the modification of the method proposed by Onishi and Sandell. The complex (RH) $GaCl_4$ is extracted with a mixture benzene-ethylacetate (3:1 V/V), from an aqueous medium 6 M in hydrochloric acid. The interference of foreign ions is studied. (C.G.C.).

52845 (Juel–2245) **Reactions of ^{11}C recoil atoms in the systems H_2O-NH_3, H_2O-CH_4 and NH_3-CH_4.** Nebeling, B. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Chemie 1 - Nuklearchemie; Koeln Univ. (Germany, F.R.). Nov 1988. 117p. (In German). Order Number DE90711199. Available from NTIS (US Sales Only), PC A06/MF A01.

In this study the chemical reactions of recoil carbon 11 in the binary gas mixtures H_2O-NH_3, H_2O-CH_4 and NH_3-CH_4 in different mixing ratios as well as in solid H_2O and in a solid H_2O-NH_3 mixture were analyzed in dependence of the dose. The analyses were to serve e.g. the simulation of chemical processes caused by solar wind, solar radiation and cosmic radiation in the coma and core of comets. They were to give further information about the role of the most important biogeneous element carbon, i.e. carbon, in the chemical evolution of the solar system. Besides the actual high energy processes resulting in the so-called primary products, also the radiation-chemical changes of the primary products were also observed in a wide range of dosing. The generation of the energetic ^{11}C atoms took place according to the target composition by the nuclear reactions $^{14}N(p,\alpha)^{11}C$, $^{12}C(^3He,\alpha)^{11}C$ or the $^{16}O(p,\alpha pn)^{11}C$ reaction. The identification of the products marked with ^{11}C was carried out by means of radio gas chromatography or radio liquid chromatography (HPLC). (orig./RB).

52846 A new $^{191}Os/^{191m}Ir$ generator system for medical use. Brihaye, C. (Oak Ridge National Lab., TN (USA)); Guillaume, M.; Knapp, F.F. Jr. pp. 669 of Radioactive isotopes in clinical medicine and research. Hoefer, R.; Bergmann, H. (eds.) Schattauer, Stuttgart, Germany, F.R. (1988). (CONF-8801130–:).

We have developed an $^{191}Os/^{191m}Ir$ generator system based on the absorption of ^{191}Os $K_2O_sCl_6$ on heat treated activated carbon. The characteristics of the generator permit the measurement of the ejection fractions of the right and left ventricles and the estimation of the transit times in arterial angiology. Regarding to the short half life of ^{191m}Ir, successive boluses can be injected every 30 sec. a period corresponding to the equilibrium production of ^{191m}Ir. This advantage is particularly interesting in the measurement of the variation of a physiological parameter under different conditions. Finally, this generator can be eluted for 3 weeks providing ^{191m}Ir activity for medical studies. (orig.).

52847 Cyclic voltammetric study of organoactinide compounds of uranium(IV) and neptunium(IV). Ligand effects on the M(IV)/M(III) couple. Sonnenberger, D.C. (Argonne National Lab., IL (USA)); Gaudiello, J.G. *Inorganic Chemistry (USA),* 27(15): 2747-2748 (27 Jul 1988). DOE Contract W-31-109-ENG-38.

The results of a cyclic voltammetric study of a series of uranium(IV) and neptunium(IV) organometallics, Cp_4M, Cp_3MCl, and Cp_2MCl_2 (Cp = η^5-C_5H_5; M = U, Np), are reported. In each case, the cyclic voltammetry of these compounds shows a single reduction wave exhibiting the characteristics of a one-electron process. The differences in the redox potential between the M(IV)/M(III) complexes in the series of compounds are smaller for neptunium than for uranium. 20 refs., 2 figs.

4008 Combustion, Pyrolysis, and High-temperature Chemistry

Refer also to citation(s) 51701, 51702, 51726, 52030, 52155, 52290

52848 Propagation of a premixed flame in a divided-chamber combustor. Cattolica, R.J. (Sandia National Labs., Livermore, CA (USA). Combustion Research Facility); Barr, P.K.; Mansour, N.N. *Combustion and Flame (USA),* 77(2): 101-122 (Aug 1989).

A study of the propagation of lean premixed ethylene-air flames in a divided-chamber combustion vessel was conducted to compare experimental observations with a numerical simulation based on a flame sheet-vortex dynamics model in axisymmetric coordinates. The temporal and spatial development of flames exiting a small cylindrical prechamber were observed in the experiments using laser-schlieren videography. The equivalence ratio of the ethylene-air mixture was varied from 0.5 to 0.65. The corresponding flame speeds S_μ for this range of equivalence ratios were measured in a complementary study and were shown to increase from 10 to 254 cm/s, respectively, while the ratio of unburned to burned gas densities varied by less than 20%. The associated increase in gas velocity with equivalence ratio was used to change the estimated Reynolds number in the experiment from 1870 to 8090. Good agreement between the predicted and measured prechamber flame propagation rates was obtained. For the lowest Reynolds number experiment the calculated spatial and temporal development of the flame in the main combustion chamber agreed with the experimental observations. For all Reynolds numbers the numerical results scale with the characteristic time scale obtained by normalizing with the burned gas flame speed S_b. In the experimental results this normalized time scale is not an accurate measure of similar flame development. As the Reynolds number was increased in the experiment the flame development was more rapid. At the highest Reyolds number conditions, a combination or the simplifying assumptions in the flame sheet-vortex dynamics model results in a slower development of the flame-vortex interaction without the experimentally observed shear layer instabilities.

52849 Hydrodynamic and reactive/diffusive instabilities in a dynamic model of liquid propellant combustion. Armstrong, R.C. (Sandia National Labs., Livermore, CA (USA). Combustion Research Facility); Margolis, S.B. *Combustion and Flame (USA),* 77(2): 123-138 (Aug 1989).

A dynamic model of liquid propellant combustion is introduced which generalizes the classical models of Landau and Levich. These earlier studies assumed that the liquid/gas interface propagated normal to itself with constant velocity, and showed that steady, planar burning was intrinsically unstable unless gravitational effects, coupled with either the effects due to surface tension or (liquid) viscosity, were sufficiently strong. In contrast, the present model assumes a more general pyrolysis burning rate law, and preliminary results reported in Part I indicate that the resulting coupling of the temperature field can render steady, planar burning stable with respect to hydrodynamic (Landau) instability even in the absence of gravity and surface tension. At the same time, a new type of reactive/diffusive pulsating instability appears for sufficiently large values of a temperature sensitivity parameters. In Part II, a complete linear stability analysis of both hydrodynamic and reactive/diffusive instabilities in the limit of zero viscosity is presented, allowing for a pressure, as well as a temperature, dependence in the burning rate law, and nonzero gravity and surface tension. The results indicate still more types of hydrodynamic and reactive/diffusive instability phenomena, as well as a stable parameter region for steady, planar deflagration.

42 ENGINEERING

Refer also to citation(s) 52527

52850 (N–89-24669) **Analysis of shell-type structures subjected to time-dependent mechanical and thermal loading. Semiannual status report.** Simitses, G. J. Georgia Inst. of Tech., Atlanta, GA (USA). May 1989. 9p. (NASA-CR–184989;NAS–1.26:184989). Available from NTIS, PC A02/MF A01.

The objective is to develop a general mathematical model and solution methodologies for analyzing structural response of thin, metallic shell-type structures under large transient, cyclic, or static thermomechanical loads. Among the system responses, which are associated with these load conditions, are thermal buckling, creep buckling, and racheting. Thus, geometric as well as material-type nonlinearities (of high order) can be anticipated and must be considered in the development of the mathematical model. Furthermore, this must also be accommodated in the solution procedures.

52851 (N–89-24673) **Large-scale structural analysis: The structural analyst, the CSM Testbed and the NAS System.** Knight, N.F. Jr.; Mccleary, S.L.; Macy, S.C.; Aminpour, M.A. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. Mar 1989. 106p. (NASA-TM–100643;NAS–1.15:100643). Available from NTIS, PC A06/MF A01.

Original contains color illustrations.

The Computational Structural Mechanics (CSM) activity is developing advanced structural analysis and computational methods that exploit high-performance computers. Methods are developed in the framework of the CSM testbed software system and applied to representative complex structural analysis problems from the aerospace industry. An overview of the CSM testbed methods development environment is presented and some numerical methods developed on a CRAY-2 are described. Selected application studies performed on the NAS CRAY-2 are also summarized.

52852 (N–89-24677) **Development of higher-order modal methods for transient thermal and structural analysis.** Camarda, C.J.; Haftka, R.T. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. Feb 1989. 39p. (NASA-TM–101548;NAS–1.15:101548). Available from NTIS, PC A03/MF A01.

A force-derivative method which produces higher-order modal solutions to transient problems is evaluated. These higher-order solutions converge to an accurate response using fewer degrees-of-freedom (eigenmodes) than lower-order methods such as the mode-displacement or mode-acceleration methods. Results are presented for non-proportionally damped structural problems as well as thermal problems modeled by finite elements.

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Refer also to citation(s) 51746, 51748, 51749, 51750, 51766, 51872, 51873, 51874, 52136, 52175, 52246, 52313, 52324, 52503, 52513, 52613, 52736, 52749, 52935, 52960, 52996, 53000, 53042, 53571, 53675, 54004

52853 (AD-A–208937/3/XAB) **Optimization of structures with passive damping and active controls. Final report, May-November 1988.** Gibson, W.C. CSA Engineering, Inc., Palo Alto, CA (USA). Feb 1989. 53p. (CSA–88-11-03). Available from NTIS, PC A04/MF A01.

Vibration suppression may be approached in three ways: by optimal distribution of structural mass, by viscoelastic damping treatments, and by active feedback control systems. Software design tools that address all three approaches are needed for SDI structures so that each approach can be exploited with minimal weight penalties. This report documents development in structural optimization under dynamic loads, both steady-state and transient. New methods for these problems are derived and demonstrated on small-scale structural models. The methods address minimization of structural mass subject to constraints on peak responses in either domain, together with frequency constraints and side constraints on member sizes. The methods are exercised with and without active control systems.

52854 (CESI–86-15) **Development of standards and of testing techniques for electrical equipment.** Brasca, E.; Rovelli, S. Centro Elecctrotecnico Sperimentale Italiano, Milan (Italy). Jun 1986. 14p. (In Italian). (CONF-8606424–2: Meeting on the future of low voltage and medium voltage switchgear, Pavia (Italy), 16-18 Jun 1986). Order Number DE89761910. Available from NTIS (US Sales Only), PC A03/MF A01.

The report describes the evolution of normatives in Italy for high voltage AC electrical equipment - circuit breakers, disconnectors and grounding switches, switches for rated voltages above 1kV and less than 52 kV, fuse-switch combinations and fuse-circuit breaker combination, metal enclosed switchgear and control equipment for rated voltages above 1 kV and up to and including 72.5 kV, and current contactors. The report then discusses the evolution of Italian testing and certification standards for motors, transformers and control boards.

52855 (CESI–86-17) **Updated test facilities for advanced technology low voltage equipment.** Jenne, P.G. Centro Elecctrotecnico Sperimentale Italiano, Milan (Italy). Jun 1986. 5p. (In Italian). (CONF-8606424–3: Meeting on the future of low voltage and medium voltage switchgear, Pavia (Italy), 16-18 Jun 1986). Order Number DE89761911. Available from NTIS (US Sales Only), PC A02/MF A01.

Attention is given to the revision of test laboratories to incorporate the following: improved computerized systems for data acquisition; measuring instruments for strong transient currents; visualization instrumentation for arc discharge phenomena; instrumentation for the measurement and evaluation of electrodynamic effects; evaluation techniques for the determination of the condition of contacts in low voltage switchgear; short circuit testing techniques for tests - on limiting loads downstream of switches, on low voltage switches at different supply frequencies and on individual poles of multi-pole low voltage switches; non-conventional testing techniques for electrical traction equipment.

52856 (DOE/EA–0364) **Nuclear Directed Energy Research Facility at Lawrence Livermore National Laboratory: Environmental assessment.** Department of Energy, Oakland, CA (USA). Jun 1989. 78p. Sponsored by U.S. DOE Environment Health & Safety. Order Number DE90001107. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This environmental assessment (EA) considers the proposed construction and operation of the Nuclear Directed Energy Research Facility (NDERF) in the southwest corner of Lawrence Livermore National Laboratory's (LLNL) Livermore site. A classified appendix has been prepared for this document that expands the discussions on chemical operations and hazardous-waste generation. NDERF would be located adjacent to the Nuclear Test Technology Complex (NTTC), with which it would share access roads, parking, landscaping, exterior lighting, and a central utility plant. The location of the two facilities, their shared parking and central plant, and NTTC operations have been treated in a separate environmental assessment. NDERF would consist of offices and laboratories where employees would perform research and development activities that currently are being conducted at the various locations within the LLNL Livermore site. The operation of NDERF would consolidate these existing activities and personnel into one facility. NDERF would serve a twofold purpose: first, it would partially fulfill the need to modernize LLNL's engineering, materials, physics and chemistry laboratory facilities and, second, would consolidate the X-Ray Laser Program, which is the current nuclear diverted energy weapon (NDEW) research program in the LLNL Defense Systems Department. NDERF operations do not require tritium or Special Nuclear Materials (SNM) (plutonium, enriched uranium), so these materials would not be in NDERF at any time. In the future, if changing activities pose increased risk to either LLNL workers or the general public, a subsequent National Environmental Policy Act (NEPA) review would be required. 39 refs., 4 figs., 15 tabs.

52857 (DP-MS–89-5-Rev.1) **PC-based calculation of activation energy using linear regression.** Bornt, F.W. Savannah River Lab., Aiken, SC (USA). [1989]. 13p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-891192–11-Rev.1: Annual Westinghouse computer symposium, Pittsburgh, PA (USA), 6-7 Nov 1989). Order Number DE89017845. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

During a severe accident, various plant locations will be subjected to harsh environments – high temperature, high humidity, high radiation, etc. Equipment required for accident mitigation located in these areas must be capable of withstanding these conditions, i.e., environmentally qualified. Qualification is normally accomplished by type testing. The equipment undergoes accelerated aging to achieve a condition equivalent to the end-of-life condition. This aging consists of accelerated thermal aging and radiation aging. The aged equipment is then subjected to simulated seismic vibration and other vibration. After a radiation exposure simulating some maximum accident exposure, the equipment is then mounted in a test chamber and operated during a simulated design basis event environment and post-accident conditions. The Arrhenius equation is used to relate the test thermal aging and accident profiles to the expected plant conditions. The test temperatures and times are

given in the equipment test report. Sometimes the activation energy is explicitly stated in the test report. More often than not, a table of aging data is the only information provided. This data can be used, with the linear regression method, to calculate the material activation energy. This article describes two PC-based methods of applying the linear regression method to the thermal aging data to obtain an activation energy. 8 refs., 1 fig., 1 tab.

52858 (ETDE-IT–89-15) **The aluminium-stabilized Nb-Ti conductor for the ZEUS thin solenoid.** Bruzzese, R.; Ceresara, S.; Donati, G.; Rossi, S.; Sacchetti, N.; Spadoni, M. ENEA, Frascati (Italy). Centro Ricerche Energia. Aug 1988. 4p. (CONF-880812–45: Applied superconductivity conference, San Francisco, CA (USA), 21-25 Aug 1988). Order Number DE89793137. Available from NTIS (US Sales Only), PC A02.

The ZEUS experiment, a huge experimental apparatus for high energy physics, is to be installed on the hadron electron ring accelerator, HERA, at DESY-Hamburg, and is to employ a superconducting thin solenoid surrounding a number of important particle detectors. The essential features of this magnet are 1.8 T magnetic field on the axis, 2.3 T max field on the conductor, inner diameter of 2 m, and solenoid length of 2.5 m. As physics requirements ask for a total solenoid thickness lower than 0.9 radiation length, a conductor consisting of a Rutherford type Nb-Ti cable cladded with high-purity aluminium was developed. This paper, reports on measurements of the main parameters needed for a complete characterization of a conductor to be used in this particular kind of magnet. Data on critical current, transfer length, and residual resistivity ratio is given and discussed in connection also with the influence that the various fabrication steps can have upon them. The final conclusion is that this conductor, using a high critical current density base strand (2.030 A/square millimeter at 6.5. T and 4.2 K), is reliable and meets the constraints of this particular project.

52859 (IEIE–8802, pp. 4) **Technology for high intensity light source.** Okad, Ikuo (Nippon Telegraph Telephon Corp., Tokyo (Japan)); Saito, Yasunao; Kakuchi, Masami; Yoshihara, Hideo. Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related to electricity and information.* Available from NTIS (US Sales Only), PC A02/MF A01.

A report on a plasma light source which utilizes the gas injection discharge method developed for X-ray exposure is made. In connection with the gas injection discharge, the method of plasma generation and its operating principle are outlined. If the point end of the plasma generating electrode is made to a shape which will collect electric field, with hollow space in the center of the electrode, the electrode wears less, resulting in stabilized discharge. For the power source, condenser discharge method is used which is simple in structure and highly reliable. The gas injection discharge shows very good discharge recurrence, producing pulse X-ray. The wave lengths of the generated X-ray depend on the types of gases used for the plasma generation. The diameter of the radiation source is approximately 1/5 of the conventional electron excitation X-ray source, and 0.2μ m pattern was confirmed to be satisfactorily transferred. The output of the generated X-ray depends on the kind of gases and discharge current values. The problem left with the plasma line source is the elongation of lives of electrodes and various electrical parts. 12 references, 7 figures.

52860 (INIS-BR–1676) **Sodium distillator II.** Goncalves, A.C.; Castro, P.M.; Torres, A.R.; Correa, S.M. Instituto de Engenharia Nuclear, Rio de Janeiro, RJ (Brazil). Div. de Metais Liquidos. [1989]. 1p. (In Portuguese). Order Number DE90606754. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Published in summary form only.

52861 (IPPJ-REV–3, pp. 129-136) **Safe-handling of tritiated water. Hood, monitoring and inventory.** Morikawa, Naotake (Tokyo Univ. (Japan). Radioisotope Center); Ijiri, Ken-ichi; Ohno, Mariko; Nogawa, Norio; Shiroya, Tsugio; Okada, Shigefumi; Tano, Shigemitsu; Nakamura, Nori. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

The systems for safe-handling of tritiated water have been developed and used on time-sharing basis in the University of Tokyo. In these systems, an effective radiation protection has been achieved by the use of two kinds of hoods. One is a hood for various biological experiments and the other is a combined hood for decontamination procedure and storage procedure including pre-treatment of high level waste. The leakage of tritiated water vapor from these hoods was negligible small under the different experimental conditions. The inner boxes were put inside the cabinet and were used for the experiments when high levels of radioactivities were handled. Tritium monitors and samplers were used for monitoring the tritium concentration of the air in the hoods, in the room and in the exhaust from the hoods. The expiratory air monitor was used for monitoring the tritium intake by the researchers during and after the experiments. The inventory of tritiated water in the biological experiments was obtained. The data of tritium monitoring and inventory showed that the present systems are very efficient for the safe-handling of tritiated water. (author).

52862 (JAERI-M–89-067) **New approach to the inverse problem of six-link manipulators via the optimization technique.** Sasaki, Shinobu. Japan Atomic Energy Research Inst., Tokyo (Japan). Jun 1989. 23p. (In Japanese). Order Number DE90710044. Available from NTIS (US Sales Only), PC A03/MF A01.

In this paper, a powerful approach is presented to solve the inverse kinematics of manipulators by associating an expression as to manipulator hand position and orientation with an optimization technique. The key point in this approach is to depart from the fixed and customary idea of dealing with all given articulated variables at a time and to pay attention to only three of them while the remaining three variables are considered to have dependent relationships with the first three variables. The linearized model of a specified performance index composed of these three variables plays an important role in determining the desired solutions. The results of computer simulation showed that numerical solutions were sufficiently reliable. Theoretically, this approach is applicable to all types of six link manipulators with rotational and/or revolute joints. (author).

52863 (LNCC–045/88) **Stress analysis in pressure vessels by mixed finite element methods taking into account shear deformation.** Franca, L.P.; Toledo, E.M.; Loula, A.F.D.; Garcia, E.L.M. Laboratorio Nacional de Computacao Cientifica, Rio de Janeiro, RJ (Brazil). Dec 1988. 16p. Order Number DE90606755. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A new finite element method is employed to approximate axisymmetric shell problems. This formulation enhances stability and accuracy, from thin to moderately thick shells, compared to the correspondent Galerkin finite element approximations. Numerical results illustrate the good performance of the present method on some typical pressure vessels aplications. (author).

52864 (N–89-24435) **Space shuttle main engine high pressure fuel turbopump turbine blade cracking.** Lee, H. National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center. May 1988. 57p. (NASA-TM–100327;NAS–1.15:100327). Available from NTIS, PC A04/MF A01.

Original contains color illustrations.

The analytical results from two-dimensional (2D) and three-dimensional (3D) finite element model investigations into the cracking of Space Shuttle Main Engine (SSME) High Pressure Fuel Turbopump (HPFTP) first- and second-stage turbine blades are presented. Specifically, the initiation causes for transverse cracks on the pressure side of the firststage blade fir tree lobes and face/corner cracks on the downstream fir tree face of the second-state blade are evaluated. Because the blade material, MAR-M-246 Hf (DS), is highly susceptible to hydrogen embrittlement in the -100 F to 400 F thermal environment, a steady-state condition (full power level = 109 percent) rather than a start-up or shut-down transient was considered to be the most likely candidate for generating a high-strain state in the fir tree areas. Results of the analyses yielded strain levels on both first- and second-stage blade fir tree

regions that are of a magnitude to cause hydrogen assisted low cycle fatigue cracking. Also evident from the analysis is that a positive margin against fir tree cracking exists for the planned design modifications, which include shot peening for both first- and second-stage blade fir tree areas.

52865 (PB–89-868244/XAB) **Sensors and detectors based on superconducting devices. July 1972-July 1989 (Citations from the International Aerospace Abstracts database). Report for July 1972-July 1989.** National Technical Information Service, Springfield, VA (USA). Aug 1989. 161p. Available from NTISPC N01/MF N01.

Supersedes PB–88-863642; U.S. sales only.

This bibliography contains citations concerning gradiometers, magnetometers, and infrared detectors which use superconductors to improve sensitivity. Applications include biomagnetic measurements for medical studies, gravity-wave experiments, geomagnetism and ocean-bottom magnetic exploration, galvanometers and voltmeters, astronomical telescopes, and bolometers and radiometers. Some articles refer to design considerations for cooling systems for the sensors and detectors. (This updated bibliography contains 389 citations, 74 of which are new entries to the previous edition.)

52866 (PB–89-868277/XAB) **Axial-flow compressors. January 1970-July 1989 (Citations from the COMPENDEX database). Report for January 1970-July 1989.** National Technical Information Service, Springfield, VA (USA). Aug 1989. 123p. Available from NTISPC N01/MF N01.

Supersedes PB–86-869815.

This bibliography contains citations concerning component design, material specifications, performance evaluations, and applications of axial-flow compressors. Applications in jet engines, gas turbines, turbofans, centrifuges, and other turbomachinery are presented. (This updated bibliography contains 308 citations, 93 of which are new entries to the previous edition.)

52867 (SAND–89-0640) **Thermal environmental tests on space simulation chamber.** Akau, R.L.; Freshour, J.P.; Wilde, S.L. Sandia National Labs., Albuquerque, NM (USA). Sep 1989. 40p. Sponsored by U.S. DOE Energy Research. DOE Contract AC04-76DP00789. Order Number DE90000927. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Thermal testing of space payloads at Sandia National Laboratories is conducted in a large cylindrical (7.0 feet in diameter) vacuum chamber with temperature controlled walls. The payload is generally attached to a baseplate with independent temperature controls. To establish well-defined boundary conditions during the tests, uniform wall temperatures are desired in the test chamber. Thermal-vacuum tests were conducted on this space simulation chamber to determine if temperature gradients existed on the chamber shroud and end-bells. Recorded temperature measurements indicated large temperature gradients on the chamber shroud and end-bells. Furthermore, it was difficult to manually control the flow of liquid to the end-bells in order to achieve equal end-bell temperatures. However, results from these tests were used in a computer program developed to predict locations on the shroud and end-balls where a thermocouple would measure the best area-weighted average temperature. These measurements provide necessary boundary temperatures that can be used in a thermal model of a satellite payload. Results were obtained for different shroud and baseplate temperature settings. 8 figs., 5 tabs.

52868 (SAND–89-1286) **Connector selection program user's guide: Version 1.0.** Sevier, N.E. Sandia National Labs., Albuquerque, NM (USA). Sep 1988. 181p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE90000926. Available from NTIS, PC A09/MF A01 - OSTI; GPO Dep.

Welcome to the Connector Selection Program. Users of all experience levels can operate the connector selection program. Its simple design, intuitive operation, and on-line Help facility make the program easy to learn and easy to use. In the hands of an engineer, it is a powerful and flexible tool. The connector selection program was developed by the Interconnections division to help component engineers and systems engineers select connectors as quickly and as easily as possible. The connector selection program is a computer database application that currently includes all the connectors listed in the 1984 MC/SA Special Design Connector Catalog which are available for new design. This list is being expanded to include connectors developed between September 1984 and present. The connector selection program is a very versatile product. It lets you perform a wide spectrum of practical connector searches and provides you with a vast amount of valuable information about each connector found. This manual discusses the use of this program.

52869 (SAND–89-1397) **Analytical framework for the LIFE2 computer code.** Sutherland, H.J. Sandia National Labs., Albuquerque, NM (USA). Sep 1989. 40p. Sponsored by U.S. DOE Management & Administration. DOE Contract AC04-76DP00789. Order Number DE90000925. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The LIFE2 computer code is a fatigue/fracture analysis code specifically designed for the analysis of wind turbine components. It is a PC-compatible Fortran code that is written in a top-down modular format. In this numerical formulation, an "S-n" fatigue analysis is used to describe the initiation, growth and coalescence of microcracks into macro-cracks. A linear, "da/dn" fracture analysis is used to describe the growth of a macro-crack. This paper presents the numerical formulations used to implement these analyses. 16 refs., 2 tabs.

52870 (SAND–89-1641C) **Evaluation of shock isolation techniques for a piezoresistive accelerometer.** Bateman, V.I.; Bell, R.G.; Davie, N.T. Sandia National Labs., Albuquerque, NM (USA). Jun 1989. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-891152–1: 60. shock and vibration symposium, Virginia Beach, VA (USA), 14-16 Nov 1989). Order Number DE89014496. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Sandia conducts impact testing for a variety of structures. In this slapdown test, one end of the cask impacts the hard concrete target, then the structure rotates so that the other end of the cask impacts the target. During an impact test, metal to metal contact may occur within the structure and produce high frequency, high amplitude shock inputs. The high frequency portion of this transient vibration has been observed to excite the accelerometer resonance even though this resonance exceeds 350 kHz. The amplitude of the resonating accelerometer response can be so large that the data are clipped and are rendered useless. If the data are not clipped, a digital filter must be applied to eliminate the undesired accelerometer resonant response. If possible, it is more desirable to prevent excitation of the accelerometer resonance, This may be accomplished by mechanically isolating the accelerometer from the high frequency excitation without degrading the transducer response in the bandwidth of interest which is usually 10 kHz or less. To achieve this desirable isolation, two mounting configurations were designed and characterized. The objective of this paper is to describe the evaluation technique and to discuss the shock isolation properties of each mounting configuration. One configuration was actually used in a field test of bomb impacting a target. 4 figs.

52871 (SAND–89-1656C) **VIBRAFUGE—Combined vibration and centrifuge testing.** Rogers, J.D.; Cericola, F.; Doggett, J.W.; Young, M.L. Sandia National Labs., Albuquerque, NM (USA). [1989]. 11p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-891152–5: 60. shock and vibration symposium, Virginia Beach, VA (USA), 14-16 Nov 1989). Order Number DE90001091. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The combined dynamic environments of vibration and linear acceleration are experienced by a large number of devices. Testing such devices has normally been a two step process in which independent vibration and centrifuge tests were performed. Concerns have existed for some time with possible combined effects from these two dynamic environments which could cause failures in the field which were not predicted form either analysis or the independent tests. This paper describes the design and performance of a testing facility which combines vibration and centrifuge testing in an single operation. The test facility is called the VIBRAFUGE and utilizes Sandia's 29 foot underground centrifuge with an attached electrodynamic shaker. 3 refs., 8 figs.

52872 (SAND–89-1678C) **Comparison of shock severity measures.** Baca, T.J. Sandia National Labs., Albuquerque, NM (USA). [1989]. 16p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-891152–3: 60. shock and vibration symposium, Virginia Beach, VA (USA), 14-16 Nov 1989). Order Number DE90000790. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In an effort to clarify the issues associated with quantifying shock severity, this paper compares the merits of two measures of shock severity. The first measure is the widely used absolute acceleration shock response spectrum (SAA). The second measure of shock severity is relatively new and is known as the shock intensity spectrum (SIS). Overall information content of SAA and SIS spectra are compared and discussed in the context of two shock excitations having known amplitude, duration, and frequency content. The first is a burst of band-limited white noise and the second is a classical haversine pulse. After describing both the SAA and SIS shock measures, numerous examples are described which emphasize the strengths and limitations of each shock characterization method. This discussion reveals how the use of different shock measures may alter an engineer's conclusions about relative shock severity between two shock environments. 8 refs., 15 figs.

52873 (SAND–89-1680C) **Location of interior impact source in randomly excited structures.** Paez, T.L.; Ernest, T.; McBride, S. Sandia National Labs., Albuquerque, NM (USA). [1989]. 13p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-891152–4: 60. shock and vibration symposium, Virginia Beach, VA (USA), 14-16 Nov 1989). Order Number DE90001092. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A technique for identifying the location of an internal impact source in a randomly excited structure is developed in this paper. It is shown that when an impact source can be modelled as a shot noise random process, a straightforward procedure can be used along with standard testing and measurement procedures to find the impact source. The results of a laboratory experiment are presented; these demonstrate the applicability of the technique. 5 refs., 7 figs.

52874 (WHC-SA–0143) **A study of the hydrothermal stability of copper for use as a container material for nuclear waste.** Hoover, J.D.; Lazaar, P.I.; Ulmer, G.C.; Grandstaff, D.E. Westinghouse Hanford Co., Richland, WA (USA). Nov 1987. 10p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC06-87RL10930. (CONF-871124–108: Fall meeting of the Materials Research Society, Boston, MA (USA), 30 Nov - 5 dec 1987). Order Number DE90001218. Available from NTIS, PC A02/MF A01; GPO Dep.

The hydrothermal stability of copper has been studied to assess its suitability as a container material for disposal of nuclear waste in the proposed repository site at Hanford, WA. The experiments (Cohassett basalt, synthetic Grande Ronde No. 4 groundwater, and copper powder with a water:rock:Cu-powder mass ratio of 20:1:1) were conducted at 300°C, 30 MPa, using Dickson rocking autoclaves for periods up to 3000 hours. Redox was calculated from dissolved H_2 measured by gas chromatograph and He-ionization detector. After *ca.* 100 hours the solution Cu concentration stabilized at 2-3 ppm, near Cu saturation, and did not vary significantly during the remainder of the experiment. The *insitu* solution pH was slightly alkaline. The copper powder showed little evidence of etching. The Cu concentration did not reflect oxide-coating spallation effects such as those described by Johnston et al. Within 48 hours, the log fO_2 values decreased rapidly toward the magnetic-hematite phase boundary (−31 at 300°C); this is well within the stability field of native copper. SEM and EDX analysis of the reaction products revealed a copper-iron sulfide. One experiment used copper powder containing *ca.* 5% cuprite. Oxygen released by the cuprite overwhelmed the buffering capacity of the basalt. 18 refs., 5 figs., 1 tab.

52875 (WSRC-RP–89-464) **Computer simulation of a nitrogen oxides absorption column at the Savannah River Site.** Peterson, S.R.; Shanahan, K.L. Westinghouse Savannah River Co., Aiken, SC (USA). [1989]. 13p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-891192–9: Annual Westinghouse computer symposium, Pittsburgh, PA (USA), 6-7 Nov 1989). Order Number DE89017875. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A computer model of a nitrogen oxides absorption column has been constructed for the purpose of testing process control strategies in a time- and cost-effective manner. The model consists of a simplified physical and chemical scheme that approximately matches real column behavior. Various feedback, feedforward, and recycle strategies have been tested, and an optimum combination selected. This combination will be tested in the plant in the near future. The overall project goals, the behavior of the real column, and how the model has been applied to process control research and development will be discussed. 3 refs., 6 figs.

52876 (WSRC-RP–89-483) **Selecting and effectively using a computer aided software engineering tool.** Kuhn, D.L. Westinghouse Savannah River Co., Aiken, SC (USA). 1989. 11p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-891192–7: Annual Westinghouse computer symposium, Pittsburgh, PA (USA), 6-7 Nov 1989). Order Number DE89017876. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Software engineering is a science by which user requirements are translated into a quality software product. Computer Aided Software Engineering (CASE) is the scientific application of a set of tools and methods to a software which results in high-quality, defect-free, and maintainable software products. The Computer Systems Engineering (CSE) group of Separations Technology at the Savannah River Site has successfully used CASE tools to produce high-quality, reliable, and maintainable software products. This paper details the selection process CSE used to acquire a commonly available CASE product and how the CSE group effectively used this CASE tool to consistently produce quality software. 9 refs.

52877 **Superconducting metallic superlattices.** Falco, C.M. (Univ. of Arizona, Tucson, AZ); Vaglio, R.; Cucolo, A. pp. 811 of Interfaces, superlattices, and thin films. Dow, J.D.; Schuller, I.K Materials Research Society, Pittsburgh, PA (1987). (CONF-8612131–: Materials Research Society symposium on interfaces, superlattices and thin films, Boston, MA (USA), 1-6 Dec 1986).

Since the coherence length is of order 50 A to 1 μm, it is possible to alternately layer thin films of a superconductor with another material to affect the physical properties of the resulting superlattice. A brief description of their sputtering technique used to prepare superlattices consisting of Nb/Cu and Ta/Mo is given. Optical interferometry, x-ray diffraction and ion beam analysis techniques independently confirm that control of +-0.3% is achieved over the amount of material deposited in each layer. Results of a study of Josephson tunneling to Nb/Cu metallic superlattices are reviewed. These measurements enable a determination of the London penetration depth to be made as a function of superlattice layer thickness.

52878 **Ring magnets for the synchrotron x-ray source at ANL.** Praeg, W.F. (Argonne Nat. Lab., Argonne, IL (US)); Thompson, K.M.; Kim, S.H. pp. 2030 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S IEEE Service Center, Piscataway, NJ (1987). (CONF-870302–: Particle accelerator conference, Washington, DC (USA), 16-19 Mar 1987).

The designs of the bending, focusing, and correction magnets for the storage ring are described. The computer-optimized pole-tip contours of the dipole, quadrupole, and sextupole magnets and the construction and assembly techniques keep the field errors within the specified limits. Horizontal and vertical steering corrections are provided by separate magnets in addition to a steering capability included in the sextupole magnets.

52879 **Response to operating conditions of the SSC magnet using nonlinear finite element analysis.** Karpenko, V.M. (Lawrence Berkeley Lab., Berkeley, CA (US)); Zaslawsky, M. pp. 2030 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S IEEE Service Center, Piscataway, NJ (1987). (CONF-870302–: Particle accelerator conference, Washington, DC (USA), 16-19 Mar 1987).

Using a plane strain 2D finite element model to represent the dipole magnet, and material properties as a function of temperature,

the operating conditions and environmental conditions were simulated to evaluate the adequacy of the design, investigate areas of nonconformance, evaluate modifications to the design, support analytically the measurement effort, and by performing a sensitivity analysis, determine what design parameters are critical. These objectives have been met by the current analysis.

52880 Achieving quality in engineering computer applications. Olhoeft, J.E. *Transactions of the American Nuclear Society (USA),* 56: 264-266 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The growing diversity and rapid changes now occurring with computer hardware and software impact the overall computing environment and quality of products. This impact occurs coincident with a trend toward increased reliance on computer applications for safety-related design, analysis, and operations of nuclear plants. This impact then becomes a driving force to evaluate existing standards and to consider good practices to ensure quality products for nuclear applications. The nuclear industry has had a long-standing record of supporting voluntary standards. Likewise, among program developers there was an early recognition that the full benefits of computer program exchange could only be achieved by voluntarily adhering to accepted guidelines. The development of such guidelines was undertaken by the STICE Committee in the early 1960s. With the subsequent establishment of the American Nuclear Society (ANS) standards organization, this committee was chartered as the ANS-10 Standards Subcommittee and produced the second ANS standard. Since these standards and good practices were generated by a variety of organizations with diverse background, experience, and need, there is a danger that misunderstanding brought about only by differences in definitions and naming conventions may mask fundamental differences or agreements in philosophy and practice. This paper attempts to establish a common basis for open discussion.

52881 The elimination of ray tracing in Monte Carlo shielding programs. Bendall, D.E. *Transactions of the American Nuclear Society (USA),* 56: 298-299 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The MONK6 code has clearly demonstrated the advantages of hole tracking, which was devised by Woodcock et at. for use in criticality codes from earlier work by Von Neumann. Hole tracking eliminates ray tracing by introducing, for all materials present in the problem, a pseudo scattering reaction that forward scatters without energy loss. The cross section for this reaction is chosen so that the total cross sections for all the materials are equal at a given energy. By this means, tracking takes place with a constant total cross section everywhere, so there is now no need to ray trace. The present work extends hole tracking to shielding codes, where it functions in tandem with Russian roulette and splitting. An algorithm has been evolved and its performance is compared with the ray-tracking code McBEND. A disadvantage with hole tracking occurs when there is a wide variation in total cross section for materials present. As the tracking uses the total cross section of the material that has the maximum cross section, there can be a large number of pseudo collisions in the materials with low total cross sections. In extreme cases, the advantages of hole tracking can be lost by the by the extra time taken in servicing these pseudo collisions; however, techniques for eliminating this problem are under consideration.

52882 Qualification of KENO calculations with ENDF/B-V cross sections. Mueller, D.E.; Boyd, W.A.; Fecteau, M.W. *Transactions of the American Nuclear Society (USA),* 56: 321-323 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The Commercial Nuclear Fuel Division of Westinghouse used KENO calculations as the basis for criticality safety analysis to cover the transportation and storage of nuclear fuel. The calculational code sequence was requalified in 1986. The basic cross-section set was changed from the ENDF/B-IV data set to the CSRL-V data. This paper discusses the benchmark effort, the results, and the application of the results to criticality analyses.

52883 Effects of poison panel shrinkage and gaps on fuel storage rack reactivity. Boyd, W.A.; Mueller, D.E. *Transactions of the American Nuclear Society (USA),* 56: 323-324 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Fixed poison panels are used in spent fuel rack designs to increase enrichment limits and reduce cell spacing; therefore, assurances that the maximum rack reactivity will meet the design limit (0.95) throughout the lifetime of the racks depend on the continued effectiveness of the poison with time. Industry data have shown that poison panels will shrink under irradiated conditions. From recent data, however, poison panels have been found to have gaps spanning their width after relatively short operating periods. This paper presents results of studies showing the fuel rack reactivity changes associated with poison panel shrinkage and formation of gaps. The discovery of gaps in the fuel rack poison panels at an operating plant raises concerns regarding the effectiveness of the poison over the lifetime of the fuel racks. Studies performed to evaluate the effect of the poison panel shrinkage on reactivity show that reactivity changes from zero to several percent are possible depending on the initial panel size. Results of recent studies show that some gaps can be accommodated in the fuel rack poison panels at the fuel midplane without causing the fuel rack K_{eff} limit to be exceeded. With worst-case assumptions concerning gap size and the number of panels affected, other actions will likely be required to show that the rack K_{eff} design limit will not be exceeded.

52884 Validation of the YAEC [Yankee Atomic Electric Company] criticality safety methodology. Napolitano, D.G.; Carpenito, F.L.; Rashid, P.J. *Transactions of the American Nuclear Society (USA),* 56: 325-328 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The Yankee Atomic Electric Company's (YEAC's) criticality safety methodology has evolved over the years to analyze high-density spent fuel rack designs, new fuel vault optimum moderation, burnup credit, pin consolidation, storage rack sensitivities, and large spent fuel rack arrays. The present methodology has three calculational paths: NITAWL-S/KENO V.a Monte Carlo, CASMO-3 integral transport, and CASMO-3/CHART-2/PDQ-7 diffusion theory analysis. These calculational paths have been validated by caparison to 21 Babock & Wilcox (B&W) fuel storage criticals. These criticals covered a range of fuel storage conditions in which criticality was maintained by a combination of water height, soluble boron, fixed poison, and array spacing. Statistical analysis of the 21 calculated k_{eff}'s gives a method bias and 95/95 method uncertainty for each path.

52885 Burnup credit for storage and transportation casks. Wells, A.H. *Transactions of the American Nuclear Society (USA),* 56: 328 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The application of burnup credit to storage and transportation cask licensing results in a significant improvement in cask capacity and an associated reduction of the cost per kilogram of uranium in the cask contents. The issues for licensing with burnup credit deal primarily with the treatment of fission product poisons and methods of verification of burnup during cask operations. Other issues include benchmarking of cross-section sets and codes and the effect of spatial variation of burnup within an assembly. The licensing of burnup credit for casks will be complex, although the criticality calculations are not themselves difficult. Attention should be directed to the use of fission product poisons and the uncertainties that they introduce. Verification of burnup by measurements will remove some of the concerns for criticality safety. Calculations for burnup credit casks should consider rod-to-rod and axial variations of burnup, as well as variability of burnable poisons it they are used in the assembly. In spite of the complexity of cask burnup credit licensing issues, these issues appear to be resolvable within the current state of the art of criticality safety.

52886 Film effects of fire sprinklers on low-enriched-uranium storage systems. McCaughey, D.A.; Bidinger, G.H. *Transactions of the American Nuclear Society (USA),* 56: 329 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The effect of low-density intraspersed moderator on k_{eff} for a large array of low-enriched commercial reactor fuel assemblies has been calculated and reported on several occasions. One source of

low-density intraspersed moderator is water from a fire sprinkler system. The mist density of water spray from a fire sprinkler system, designed to National Fire Protection Association standards, can be calculated. A typical design volume fraction is 0.0075 vol%. Even allowing for uncertainties such as water drop size, water drop velocity, and overlapping of sprays from multiple sprinkler heads, the density from a sprinkler system is usually <0.1 vol%. The calculated increased in k_{eff} for the dry storage and intraspersed moderator at 0.1 vol% is relatively insignificant. One effect that has been alluded to is the effect of water films on array k_{eff}. This effect has been considered for a water film on a plastic dust wrapper surrounding the fuel assembly. For this paper, the film effect has been calculated for each fuel pin, rather than for the fuel assembly. The film thickness for vertical rods was calculated using the Nusselt method.

52887 **A computerized control system for critical facilities at Los Alamos National Laboratory.** Spriggs, G.D. (Los Alamos National Lab., NM (USA)); Martin, E.R. *Transactions of the American Nuclear Society (USA),* 56: 331-332 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

For many years, the control systems at the Los Alamos Critical Experiments Facility (LACEF) have been hard-wired analog mechanical and electromechanical switches and relays, which do not lend themselves to easy reconfiguration nor to direct interfacing with modern computerized equipment. Accordingly, with the advent of computerized data acquisition systems, it was decided to replace the control systems in one of the remote operations areas with computer-controlled equipment that could be rapidly reconfigured for new experiments. Initial concerns over unresolved safety questions have now largely been answered by several hundred hours of computerized operation under actual critical conditions with no safety problems and with greatly enhanced operator control. The new digital system is electrically quieter, more easily reconfigured, infinitely more versatile than its atavistic ancestors, and gives great promise for easy expansion to new systems in the future.

52888 **Remote radiation monitoring in critical experiments.** Martin, E.R. (Los Alamos National Lab., NM (USA)); Spriggs, G.D. *Transactions of the American Nuclear Society (USA),* 56: 332-333 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

For critical experiments, it is necessary to monitor remotely approaches to criticality via ionization chambers in order to ensure compliance with experimental requirements and that reactor power restrictions are not exceeded. In addition, the remotely monitored ionization chamber current serves as a convenient means to provide operator feedback for control of an orderly approach to critical. These measurements must span several decades, however, and still provide linear power indication for vernier control. Traditionally, strip chart recorders have been used with linear amplifiers whose ranges could be changed as needed for providing this information and also for providing archival storage of the approach to critical for future verification. The paper describes a new instrument for taking and displaying ionization chamber data remotely, which eliminates the need for bulky and clumsy chart recorders, provides autoranging of linear display information, and utilizes floppy magnetic disks for archival storage of run data. It also provides easy interfacing with computerized control systems.

52889 **The ^{252}Cf noise analysis method for in-plant criticality safety.** Mihalczo, J.T. *Transactions of the American Nuclear Society (USA),* 56: 334-335 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The ^{252}Cf-source-driven neutron noise analysis method for obtaining the subcritical neutron multiplication factor k_{eff} of a configuration of fissile material from cross-power spectral densities (CPSDs) was developed to avoid difficulties inherent in other subcriticality measurement methods. These difficulties include a need for a calibration at a known reactivity condition near delayed critical and a dependence on detection efficiency that may be more dependent on the configuration of fissile material than k_{eff}. This method has promise for in-plant applications as has been demonstrated in ≈20 experiments with a wide variety of fissile material configurations. These experiments conducted between 1975 and 1987 included static measurements between k_{eff} values of 0.3 and 0.999 and dynamic measurements between k_{eff} values of 0.3 and 0.96. This noise analysis method has applications for (a) verification of criticality safety, (b) process control, (c) optimization of plant storage of fissile material, (d) long-term storage of spent light water reactor (LWR) fuel, (e) quality assurance testing of fuel elements after production, and (f) verification of k_{eff} of shipments as received at storage or process facilities. This paper discusses the implications of experiments for these applications and equipment required for in-plant applications.

52890 **Plant protection system to assure criticality safety in uranium extraction.** Wilson, R.E. *Transactions of the American Nuclear Society (USA),* 56: 335-336 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The criticality safety of uranium reprocessing at the Idaho Chemical Processing Plant depends on the control of the uranium concentration in large vessels. Many of these controls are high-quality barriers meeting the standards of a plant protective system (PPS). The first-cycle extraction PPS has been in use since 1979; the second-cycle extraction system will be equipped with a PPS shortly and the fluorinel dissolution process has had an extensive PPS since startup in 1984. The criteria for these PPSs are based on reactor development technology standard C16-IT and standard 603 of the Institute of Electrical and Electronics Engineers. These reactor plant standards were adapted and formalized for the conditions of fuel processing. The application to the first-cycle extraction operation is described in this paper. The PPS has worked reliably and effectively since its installation. Component malfunction causes inadvertent system trips less than annually. The system provides assurance of a controlled operation with little effect on productivity. As such it relieves the burden on operational supervision. In the only know PPS challenge, the CX nitric acid concentration monitor detected the results of a nitric acid leak into the makeup tank after sampling and prevented an increase in uranium concentration in the downstream mixer settler vessel.

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Refer also to citation(s) 52939, 52940, 52941, 52942, 52967, 52978, 53040, 53132, 53980

52891 (AD-A–208643/7/XAB) **Standard chemical oxygen-iodine laser kinetics package. Revision. Final report, August 1987-March 1988.** Perram, G.P.; Hager, G.D. Air Force Weapons Lab., Kirtland AFB, NM (USA). Oct 1988. 33p. (AFWL-TR–88-50-REV). Available from NTIS, PC A03/MF A01.

Supersedes AD-A202 223. Includes errata sheet dated 27 Apr 89.

It has been long recognized that continuous-wave (CW) chemical lasers represent an extremely complex interaction between fluid mechanics, chemical kinetics, and optical physics. The chemical oxygen-iodine laser presents additional problems in that the energy-storage medium, singlet oxygen, is generated by a liquid-gas phase reaction. The kinetics of chemical oxygen-iodine lasers can be divided into five categories: (1) the chemistry of singlet oxygen generators, (2) the chemistry of COIL in the presence of water aerosols, (3) transport of singlet oxygen in the absence of iodine, (4) the dissociation of molecular iodine by excited oxygen, and (5) the kinetics of iodine atoms and excited oxygen. Only the last three kinetics topics are covered in this review. This report presents the Air Force Weapons Laboratory Standard Chemical Oxygen-Iodine Laser Kinetics Package. A complete reaction scheme including recommended rate coefficients for modeling the gas phase kinetics of chemical oxygen-iodine lasers (COIL) was established to provide a common basis for the research and development of COIL devices. A review of the experimental kinetic data base from which the model was derived is also presented. However, the fully coupled, reactive mixing and optical physics problems inherent in supersonic chemical oxygen-iodine lasers are not addressed.

52892 (AD-A–209052/0/XAB) **Efficient second-harmonic generation of a diode-pumped c-w Nd:YAG laser using an externally resonant cavity.** Byer, R.L.; Nabors, C.D.; Kozlovsky, W.J. Stanford Univ., CA (USA). Edward L. Ginzton Lab. 1988. 6p. Available from NTIS, PC A02/MF A01.

Pub. in Spie: Miniature Optics and Lasers, Vol. 898, 105-109(1988).

Diode-pumped solid-state lasers are efficient and compact sources of coherent IR radiation, but for many applications short-wavelength visible sources are desired. Intracavity frequency doubling is a proven method of efficient conversion of these lasers to the visible, but generally results in deeply amplitude-modulated output. An alternative approach is external cavity frequency doubling to provide stable single-axial-mode output at the second harmonic. The authors used external-cavity frequency doubling to generate 56% second-harmonic conversion efficiency of a 53 mW, cw, diode-laser-pumped Nd:YAG oscillator. A monolithic cavity of MgO:LiNbO3 resonant at the fundamental was used to generate the 30 mW of single axial mode 532 nm radiation.

52893 (AD-A-209054/6/XAB) **Efficient second-harmonic generation of a diode-laser-pumped c-w Nd:YAG laser using monolithic MGo:LINbO_3 external resonant cavities.** Byer, R.L.; Nabors, C.D.; Kozlovsky, W.J. Stanford Univ., CA (USA). Edward L. Ginzton Lab. Jun 1988. 9p. Available from NTIS, PC A02/MF A01.

Pub. in IEEE Jnl. of Quantum Electronics, Vol. 24, No. 6, 913-913(Jun 1988).

The authors report 56% efficient external-cavity-resonant second-harmonic generation of a diode-laser pumped, C-W single-axial-mode Nd:YAG laser. A theory of external doubling with a resonant fundamental is presented and compared to experimental results for three monolithic cavities of nonlinear MgO: LiNbO_3. The best conversion efficiency was obtained with a 12.5-mm long monolithic ring cavity doubler, which produced 29.7 MW of C-W, single axial mode 532-nm radiation from an input of 52.6 mW. There has been increasing interest in the development and applications of diode-laser-pumped solid-state lasers. Diode-laser-pumped lasers offer improved reliability, efficiency, and frequency stability compared to lamp-pumped lasers. An important application of diode-laser-pumped solid-state lasers is in the generation of visible radiation by frequency doubling 2.

52894 (AD-A-209057/9/XAB) **Coherent 70.9-nm radiation generated in neon by frequency tripling the fifth harmonic of a Nd:YAG laser.** Byer, R.L.; Lago, A.; Wallenstein, R.; Chen, C.; Fan, Y.X. Stanford Univ., CA (USA). Dept. of Applied Physics. Mar 1988. 4p. Available from NTIS, PC A02/MF A01.

Pub. in Optics Letters, Vol. 13, No. 3, 221-223(Mar 1988).

Coherent radiation is produced in the XUV region of 70.9 nm by frequency tripling the fifth harmonic of Nd:YAG laser radiation in neon. BaB2O.4 was used to generate the fifth harmonic at 212.8 nm with an output pulse energy of 20 mJ and a pulse width of 5 sec. Subsequent frequency tripling in neon gas generated 10 W of peak power at 70.9 nm.

52895 (AD-A-209062/9/XAB) **Tunable microwigglers for free-electron lasers.** Chen, S.C.; Bekefi, G.; DiCecca, S.; Temkin, R. Massachusetts Inst. of Tech., Cambridge, MA (USA). 3 Apr 1989. 4p. Available from NTIS, PC A02/MF A01.

Pub. in Applied Physics Letters, Vol. 54, No. 14, 1299-1301(3 Apr 1989).

The design, construction, and test results of a novel microwiggler structure with a periodicity of 2.4 mm are presented for free-electron laser applications. The experimentally demonstrated tunability of field amplitude provides versatile means for field tapering, optical klystron configurations, improving field uniformity, and electron beam matching at the wiggler entrance.

52896 (AD-A-209129/6/XAB) **NS(B) (nitrogen sulfide (B state)) spectrum theory and code. Technical report, January-May 1989.** Lawconnell, R.I. Frank J. Seiler Research Lab., United States Air Force Academy, CO (USA). May 1989. 58p. (FJSRL-TR-89-0005). Available from NTIS, PC A04/MF A01.

Availability: Document partially illegible.

During the past year the Laser Kinetics Branch has been studying the B2II - X2II transition in nitrogen sulfide. There was particular interest in this transition because the author feels the B state 1-microsecond lifetime and large Franck-Condon shift make it a good short wavelength chemical-laser candidate. As part of the study the rotational and vibrational populations of the excited molecule produced in an S+N_3 to NS(B) + N_2 reaction were determined. To do this accurately it was necessary to write a spectrum code. This document outlines the theory, explains how to run, and provides a listing of the spectrum code and accompanying files. It should be noted that even though this code was written specifically for the NS(B2II) - NS(X2II) transition, it is easily modified to do a variety of other molecules and transitions.

52897 (CONF-8909211-1) **Prospects for wavelength tunable lasers based on vacancy defects in alkaline-earth oxides.** Chen, Y.; Orera, V.M.; Gonzalez, R. Oak Ridge National Lab., TN (USA). Sep 1989. 8p. Sponsored by U.S. Department of Defense. DOE Contract AC05-84OR21400. From 5. international tunable laser conference; Irkutsk (USSR); 20-23 Sep 1989. Order Number DE90001078. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Research on color centers in the alkali halides has proven fruitful in that the recent development of tunable lasers was a direct outgrowth of the studies. It is expected that research on the alkaline-earth oxides will also hear bear fruit in this area. In this article we discuss the merits and problems of using defects for tunable lasers. Our discussions shall be confined to CaO and MgO crystals. Vacancies such as the F^+ center (an anion vacancy with one electron which is therefore positively charged with respect to the lattice) constitute a four-level system. Vacancies can provide higher gain than transition metal or rare-earth ions. 15 refs., 5 figs.

52898 (DOE/ER/30131-T8) **Assessment of research needs for laser technologies applied to advanced spectrographic methods.** Consultec Scientific, Inc., Knoxville, TN (USA). Nov 1989. 128p. Sponsored by U.S. DOE Energy Research. DOE Contract AC01-88ER30131. Order Number DE90001154. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

The Department of Energy (DOE) recognizes that new developments in laser technology and laser spectroscopy can substantially improve the ability to carry out the mission of its Office of Health and Environmental Research (OHER). In brief, the mission of OHER is to support programs of research which provide the knowledge necessary for DOE to protect the human health and the environment from potentially adverse effects associated with the production and utilization of energy resources. For some years, the OHER program has included some support for the development of laser technology, and especially laser spectroscopy. This support has provided the bases for the demonstration of remarkably sensitive laser systems for the detection of chemical substances at the atomic and the molecular levels. At the present time, both laser technology and laser spectroscopy are surging ahead at an unprecedented rate. Thus, DOE requested that its Office of Program Analysis conduct a study to identify the opportunities in this laser revolution to further enhance the role of laser spectroscopy in the OHER mission. This DOE study was managed by Consultec Scientific, Inc., who furnished from its staff the Principal Investigator, who, in turn, coordinated the enthusiastic efforts of a group of consultants consisting of some of the world's best scientists in the development and use of laser technology for spectroscopic purposes. This expert panel, during the course of its study, took a global view of laser science and from this perspective identified a number of recent developments which could substantially improve the ability of OHER to perform its increasingly important mission.

52899 (ENEA-RT-TIB-86-57) **Study of a high energy X-ray preionized discharge XeCl laser.** Di Lazzaro, P.; Giordano, G.; Letardi, T.; Sabia, E.; Boffa, B.; Bollanti, S.; Hermsen, T. ENEA, Frascati (Italy). Centro Ricerche Energia. Mar 1987. 11p. (CONF-8609396-1: European conference on optics, optical systems and applications, Florence (Italy), 30 Sep - 3 oct 1986). Order Number DE89761930. Available from NTIS (US Sales Only), PC A03.

The results of a detailed experimental study on a high energy, high uniformity, X-ray preionized XeCl laser, completely realized at the ENEA center of Frascati, are presented. Electrical and gain characteristics of the laser device were investigated over a wide range of operating conditions. Output laser energy up to 3.2 J with high beam uniformity, intrinsic efficiency up to 4%, time and spectrally resolved small signal gain with peak value of 4.5% cm^{-1} at 400 kW/cm^3 pumping energy density, were obtained.

52900 (IEIE–8802, pp. 4) **Laser technology.** Kaneko, Hideji (Toshiba Corp., Kawasaki (Japan)); Tamagawa, Toru; Yagyu, Satoru. Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related to electricity and information.* Available from NTIS (US Sales Only), PC A02/MF A01.

Concerning gas laser, particularly CO_2 gas laser used for high power processing machines and high power pulse laser, the trend of the development in discharge technology is briefly described. Representative gas lasers are grouped and introduced by excitation media. Although gases and operating pressures differ according to the kinds of laser, glow discharge in mixed gases is common for all of the lasers. Recently, direct current glow discharge has been replaced by high frequency discharge system which can easily be miniturized, and the development of the system has been carried on. A very large laser has been developed which operates under high pressure, and is called the Transversely Excited Atmospheric (TEA) laser. Outline of the high power CO_2 gas laser for machining is reported. Pulse lasers which outputs strong momentary laser beam in very short time have been developed in many places, and they can be applied to semiconductor manufacturing facilities, uranium enrichment equipment, etc.. An example of the sectional view of a typical pulse laser is shown. 8 references, 4 figures, 1 table.

52901 (IEIE–8802, pp. 4) **Role of N_2 in laser excitation.** Yagi, Sigenori (Mitsubishi Electric Corp., Tokyo (Japan)); Katsumoto, Masaki. Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related to electricity and information.* Available from NTIS (US Sales Only), PC A02/MF A01.

The role of N_2 in laser excitation is reported taking an example with CO_2 laser excited by the discharge of high frequency alternate current using a dielectric substance. It is a well-known fact that the role of N_2 in CO_2 laser excitation is to improve the excitation efficiency by resonant transfer of vibrational energy. The reduced electric field varies with the type of discharge, and optimization of gas composition is required for each discharge. Oscillation output characteristics are shown with gas composition and gas pressure as the parameters. There is a linear relationship between the discharge power and oscillation output. Slope does not depend on gas pressure, and depends on gas composition only. As compared with SD, DC, and RF discharges, the reduced electric field is high because of its discharge mechanism. It was found that the optimum N_2 composition is 60% which is an amazingly high concentration judging from the generally accepted idea on laser. 7 references, 6 figures.

52902 (LA-UR–89-2851) **Workshop results on small-period wiggler designs.** Sheffield, R.L.; Booske, J.H.; Warren, R.W.; Halbach, K.; Danly, B.; Jackson, B.; Walstrom, P.; Slater, J.; Toor, A. Los Alamos National Lab., NM (USA). 1989. 16p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-8908134–5: 11. international free electron laser conference, Naples, FL (USA), 28 Aug - 1 sep 1989). Order Number DE90000611. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In this paper, we present a review of a workshop on small-period wiggler and undulator designs held at Los Alamos National Laboratory on April 13, 1989. The wiggler designs are based on the following mechanisms: microwave fields, electromagnetic coils, miniature permanent magnets, current sheets, superconductive coils, and iron-free pulsed wire. 9 refs.

52903 (N–89-23860) **High-power single spatial mode Al-GaAs channeled-substrate-planar semiconductor diode lasers for spaceborne communications. Final report, 16 July 1987-15 October 1988.** Connolly, J.C.; Carlin, D.B.; Ettenberg, M. David Sarnoff Research Center, Princeton, NJ (USA). Jun 1989. 98p. (NASA-CR–4238;NAS–1.26:4238). Available from NTIS, PC A05/MF A01.

A high power single spatial mode channeled substrate planar Al-GaAs semiconductor diode laser was developed. The emission wavelength was optimized at 860 to 880 nm. The operating characteristics (power current, single spatial mode behavior, far field radiation patterns, and spectral behavior) and results of computer modeling studies on the performance of the laser are discussed. Reliability assessment at high output levels is included. Performance results on a new type of channeled substrate planar diode laser incorporating current blocking layers, grown by metalorganic chemical vapor deposition, to more effectively focus the operational current to the lasing region was demonstrated. The optoelectronic behavior and fabrication procedures for this new diode laser are discussed. The highlights include single spatial mode devices with up to 160 mW output at 8600 A, and quantum efficiencies of 70 percent (1 W/amp) with demonstrated operating lifetimes of 10,000 h at 50 mW.

52904 (N–89-24599) **Development of mid-infrared solid state lasers for spaceborne lidar. Progress report, 13 October 1988-13 April 1989.** Whitney, D.A.; Kim, K.H. Hampton Inst., VA (USA). Apr 1989. 39p. (NASA-CR–185012;NAS–1.26:185012). Available from NTIS, PC A03/MF A01.

The laser performance of a Ho(3+):Tm(3+):Cr(3+):YAG crystal was measured under flashlamp pumping at various operating temperatures. The normal mode laser thresholds of a Ho(3+)(0.45 at. percent):Tm(3+)(2.5 at. percent):Cr(3+)(1.5 at. percent):YAG crystal were found to range from 26 to 50 J between 120 and 200 K with slope efficiencies up to 0.36 percent with a 60 percent reflective output mirror. From the Q-switched operations a slope efficiency corresponding to 90 percent of the normal mode operation was observed. Laser wavelengths were measured for various operating conditions and fluorescence spectra were obtained at various temperatures in order to help understand the dynamic energy processes among the Ho(3+), Tm(3+), and Cr(3+) ions. A pulse forming network for a flashlamp pumped Cr:GSAG laser, which is to be used as a high power laser diode simulator in rare earth laser pumping, was completed and tested. The network provided critically damped, 1 ms FWHM, square pulses with a rise time of about 160 micrometers at an input electrical energy of 300 J.

52905 (N–89-24601) **Prototype laser-diode-pumped solid state laser transmitters. Final report, April 1987-June 1989.** Kane, T.J.; Cheng, E.A.P.; Wallace, R.W. Lightwave Electronics Corp., Mountain View, CA (USA). Jun 1989. 65p. (NASA-CR–185056;NAS–1.26:185056). Available from NTIS, PC A04/MF A01.

Monolithic, diode-pumped Nd:YAG ring lasers can provide diffraction-limited, single-frequency, narrow-linewidth, tunable output which is adequate for use as a local oscillator in a coherent communication system. A laser was built which had a linewidth of about 2 kHz, a power of 5 milliwatts, and which was tunable over a range of 30 MHz in a few microseconds. This laser was phase-locked to a second, similar laser. This demonstrates that the powerful technique of heterodyne detection is possible with a diode-pumped laser used as the local oscillator. Laser diode pumping of monolithic Nd:YAG rings can lead to output powers of hundreds of milliwatts from a single laser. A laser was built with a single-mode output of 310 mW. Several lasers can be chained together to sum their power, while maintaining diffraction-limited, single frequency operation. This technique was demonstrated with two lasers, with a total output of 340 mW, and is expected to be practical for up to about ten lasers. Thus with lasers of 310 mW, output of up to 3 W is possible. The chaining technique, if properly engineered, results in redundancy. The technique of resonant external modulation and doubling is designed to efficiently convert the continuous wave, infrared output of our lasers into low duty-cycle pulsed green output. This technique was verified through both computer modeling and experimentation. Further work would be necessary to develop a deliverable system using this technique.

52906 (UCID–21801) **The current status of x-ray conversion efficiency modeling.** Langer, S. Lawrence Livermore National Lab., CA (USA). 7 Aug 1989. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90000931. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Conversion efficiency (CE) experiments measure the fraction of the energy in a laser beam illuminating a (gold) disk which is converted into x-rays. In the summer of 1987 a series of experiments

using gold disks made of a mixture of gold and beryllium was performed. These experiments produced high quality data on the spatial, temporal, and spectral properties of the x-rays emitted by laser illuminated disks, as well as measuring the CE. The new and more detailed results have prompted several revisions in modeling of the conversion process. This paper provides a summary of the status of conversion efficiency modeling and shows that the models accurately reproduce many features of the data. 2 refs., 17 figs.

52907 (UCID–21803) **Laboratory x-ray lasers.** Matthews, D.L. Lawrence Livermore National Lab., CA (USA). Aug 1989. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90000879. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

One of the most innovative spinoffs of ICF technology and physics has been the development of the x-ray wavelength laser. The first incontrovertible demonstration of this type of laser came from LLNL in 1984 using the Novette laser to pump a selenium foil target. The power and energy of Novette were then needed to produce a column of plasma of sufficient length to achieve a sufficient gainlength product (~5.5, this corresponds to an amplification of ~250X) that could unquestionably illustrate the lasing effect. LLNL ICF expertise was also required to develop time-resolved spectrometers used to view the lasing transitions at ~20 nm, a region of the XUV spectrum normally dominated by high backgrounds. The design of the x-ray laser amplifier, which required maintaining nonequilibrium level populations in a tailored plasma having the proper conditions for gain and x-ray laser beam propagation, was accomplished with modified versions of ICF kinetics and hydrodynamics codes. Since the first demonstration, our progress in the development of the x-ray laser has been rapid. New achievements include production of megawatt power levels at 20 nm, amplified spontaneous emission levels approaching saturation intensity (GL ~17 @ 20 nm, efficiency [x-ray laser energy/pump energy] ~10^{-6}), the demonstration of double and triple pass amplification [hinting at the possibility of producing x-ray wavelength resonators], the focusing of x-ray lasers to pump other types of lasers and the first demonstration of an x-ray hologram produced by an x-ray laser. The generation of amplification at ever shorter wavelength is possible using various types of inversion schemes. We depict below this progress benchmarked against production of gain in the water window (2.2 to 4.4 nm,), where applications to biological imaging may be facilitated.

52908 (UCRL–100786) **Spectroscopic and laser properties of Cr:LiCaAlF$_6$ and Cr:LiSrAlF$_6$ crystals.** Krupke, W.F.; Payne, S.A.; Chase, L.A. Lawrence Livermore National Lab., CA (USA). Aug 1989. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8909211–2: 5. international tunable laser conference, Irkutsk (USSR), 20-23 Sep 1989). Order Number DE90000783. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Cr:LiCAF and Cr:LiSAF have been found to be excellent materials for efficient, tunable, chromium lasers. Their physical, thermal, optical, and spectroscopic properties permit efficient laser emission at the watt level under laser pumping, tunable over the range 740-920 nm. Flashlamp pumping has generated joule level output energy without appearance of deleterious solarization effects. Further improvements in laser performance are anticipated as laser crystals of higher quality become available. This report covers work on the laser properties of Cr:LiCAF and Cr:LiSAF crystals.

52909 Optical materials for laser applications. Jacobs, S.D. 1p. American Institute of Chemical Engineers, New York, NY (1988). (CONF-881143–: American Institute of Chemical Engineers annual meeting, Washington, DC (USA), 27 Nov - 2 dec 1988).

Technical Paper 136A.

Selected research topics in the areas of high average power solid-state lasers, improved nonlinear frequency converters, liquid crystal devices, and dielectric thin film coating technology are discussed. Specific subjects are: strengthened laser glass; glassy polymer protective coatings for nonlinear crystals; liquid crystal devices for laser applications; and thin film coating technology.

52910 Silicon treatments of harmonic conversion crystals to improve surface quality and optical transmission. Thomas, I.M. (Lawrence Livermore National Lab., CA (USA)). pp. 443 of OSA conference on lasers and electro-optics (1989 Technical Digest series). Optical Society of America, Washington, DC (1989). (CONF-890423–: CLEO '89: conference on lasers and electro optics, Baltimore, MD (USA), 24-28 Apr 1989).

Technical Paper TUG1.

Potassium dihydrogen phosphate (KDP) harmonic conversion crystals normally have surface irregularities, particularly if a diamond turning process was used to produce the optical surface rather than more conventional polishing. These irregularities, especially the diamond turning lines, can cause laser beam distortion. The authors have been investigating methods of eliminating this problem by using coatings of similar refractive index to that of the substrate. These coatings are expected to fill imperfections and give smooth uniform surfaces. The authors give further details on coating preparation, the reflection spectra of the various coating combinations, and damage threshold measurements.

52911 Ultrashort pulse energy extraction measurements in XeCl amplifiers. Taylor, A.J. (Los Alamos National Lab., Laser Science and Applications Group, Los Alamos, NM (US)); Roberts, J.P.; Gosnell, T.R. pp. 443 of OSA conference on lasers and electro-optics (1989 Technical Digest series). Optical Society of America, Washington, DC (1989). (CONF-890423–: CLEO '89: conference on lasers and electro optics, Baltimore, MD (USA), 24-28 Apr 1989).

Technical Paper MG5.

The XeCl gain medium with its large spectral bandwidth and high photon energy is an excellent candidate for amplification of ultrashort pulses to high power levels. High brightness subpicosecond XeCl laser sources have delivered peak optical powers of up to 1 TW. The bandwidth limited pulse duration for the XeCl gain medium is –200 fs and can be fully exploited by combining nonlinear frequency doubling in BBO or KDP with standard femtosecoond dye laser technology to generate UV seed pulses. For pulse durations approaching the bandwidth limit, however, gain suppression and pulse broadening can occur and result in deviations from standard pulse propagation theories. To gain understanding of the effect of limited bandwidth on ultrashort pulse amplification, the authors present here energy extraction measurements for a XeCl amplifier performed with 200-fs and 3-ps pulses. The implications of these measurements for the design of ultrahigh brightness excimer systems are discussed.

52912 Applications of new solid state lasers to the production of tunable VUV and XUV coherent radiation. Muller, C.H. (Spectra Technology, Inc., Bellevue, WA (USA)); Guyer, D.R.; Hamilton, C.E.; Lowenthal, D.D.; Raymond, T.D.; Smith, A.V. pp. 443 of OSA conference on lasers and electro-optics (1989 Technical Digest series). Optical Society of America, Washington, DC (1989). (CONF-890423–: CLEO '89: conference on lasers and electro optics, Baltimore, MD (USA), 24-28 Apr 1989).

Technical Paper MH3.

The authors have recently demonstrated a 7.5% efficient near-diffraction-limited coherent VUV source operating at –130 nm. The VUV wavelengths are obtained by two-photon resonant four-wave mixing in Hg vapor. Output VUV energies exceeding 1.25 mJ/pulse in 8-mm diam beams have been obtained. The VUV wavelength is tunable from 120 to 140 nm by adjusting the pump wavelengths for proper index matching conditions. In this article, the authors discuss the characteristics of their 130-nm source, recently developed single-mode Ti:S oscillators, and their use with tabletop VUV and XUV sources.

52913 Flashlamp-pumped performance of the solid state laser material LiCaAlF$_6$:Cr^{3+}. Chase, L.L. (Lawrence Livermore National Lab., CA (USA)); Payne, S.A.; Marion, J.E.; Smith, L.K.; Chai, B.H.T.; Newkirk, H.W.; Kway, W.; Davis, L.; Shinn, M.D.; Woods, B. pp. 443 of OSA conference on lasers and electro-optics (1989 Technical Digest series). Optical Society of America, Washington, DC (1989). (CONF-890423–: CLEO '89: conference on lasers and electro optics, Baltimore, MD (USA), 24-28 Apr 1989).

Technical Paper TUJ59.

The authors recently demonstrated that the LiCaAlF$_6$:Cr^{3+} (Cr:LiCAF) crystal can be operated efficiently as a tunable solid state laser medium when pumped in the laser pumped laser configuration. Encouraged by this result, they investigated flashlamp

pumping of Cr:LiCAF and measured several of its thermomechanical properties, which can be used to predict the potential performance of this material. They are also developing the growth techniques and conditions required to obtain large single crystal rods. The results appear quite promising. The authors grew crystals by the horizontal zone melting, vertical Bridgman, and Czochralski techniques and have thus far obtained by the Czochralski method a laser rod of 0.63 X 4-cm dimensions that has good optical quality. Crystal growth problems currently being addressed include the volatization of AlF_3 and Li_3AlF_6 from the melt and loss of the CrF_3 dopant. The authors demonstrated successful flashlamp pumped operation with a 0.5- X 2-cm laser rod of Cr:LiCAF in a nonoptimized helical flashlamp cavity and have found that the performance of Cr:LiCAFR is similar to that obtained for an alexandrite ($Cr:BeAl_2O_4$) laser rod mounted in the same cavity. It also appears that Cr:LiCAF does not have a strong tendency to solarize.

52914 Ultrahigh brightness laser program. Perry, M.D. (Lawrence Livermore National Lab., CA (USA)); Patterson, F.; Campbell, E.M.; Bado, P.; Mourou, G.A. pp. 443 of OSA conference on lasers and electro-optics (1989 Technical Digest series). Optical Society of America, Washington, DC (1989). (CONF-890423–: CLEO '89: conference on lasers and electro optics, Baltimore, MD (USA), 24-28 Apr 1989).

Technical Paper TUT2.

New short pulse laser technology has made possible the production of extremely bright ($>10^{18}$-W/cm^2 sr) laser sources. Use of these new techniques on a large scale Nd:glass-based laser system makes possible the production of subpicosecond 1000-TW (betawatt) pulses. Such pulses can yield focused intensities exceeding 10^{-21} W/cm^2, corresponding to an electric field in excess of 100 e/a^2_0 and an energy density equivalent to that of a 10-KeV blackbody. Such a source would have important applications in many areas of research. A program to develop the technology to produce such pulses has been initiated at Lawrence Livermore National Laboratory. The program has three initial goals: (1) construction of a 10-TW beam line for research in large scale chirped pulse amplification; (2) development of a high contrast subpicosecond 1.053-μm laser oscillator; (3) development of large scale, damage resistant compression gratings. The first two of these areas are concerned with the production of high contrast (no prepulse), near diffraction limited, subpicosecond pulses with an energy per pulse of 10 J. Such pulses cannot be achieved by relying solely on chirped pulse amplification when the initial chirped pulse is generated by self-phase modulation in optical fibers. Methods for the production of such clean pulses are discussed as well as the technical status of each initial program goals.

52915 A 100-J tuned laser for ionization of lithium in a PBFA-II ion source. Tisone, G.C. (Sandia National Labs., Albuquerque, NM (USA)); Hurst, M.J.; Clark, B.F. pp. 443 of OSA conference on lasers and electro-optics (1989 Technical Digest series). Optical Society of America, Washington, DC (1989). (CONF-890423–: CLEO '89: conference on lasers and electro optics, Baltimore, MD (USA), 24-28 Apr 1989).

Technical Paper WF5.

A high power coaxial flashlamp pumped dye laser system with a master oscillator, two amplifier chains, two output beams, and five flashlamp modules has been installed in the PBFA-II operating system with its large dye circulator and 400 m of transfer plumbing. The system has been characterized, tuned to 670.8 nm using sulfarhodamine 640 and oxazine 720 in solvent mixtures of ethylene glycol/water, ethylene glycol/methanol, pure methanol, and ethylene glycol/ethanol. Measurements of the energy out, bandwidth, beam quality, and wavelength tuning are discussed. The use of this laser to produce an ion source for PBFA-II is discussed.

52916 Absorption at 248 nm in electron-beam pumped noble gases. McCown, A.W. (Los Alamos National Lab., NM (USA)); Hanson, D.E.; Rose, E.A.; Czuchlewski, S.J.; Bell, T.M.; Godard, J.A.B. pp. 443 of OSA conference on lasers and electro-optics (1989 Technical Digest series). Optical Society of America, Washington, DC (1989). (CONF-890423–: CLEO '89: conference on lasers and electro optics, Baltimore, MD (USA), 24-28 Apr 1989).

Technical Paper THP5.

The authors report absorption measurements in electron-beam pumped noble gases in the vicinity of 248 nm over a range of pressures and pump powers relevant to the KrF lasers which are being considered as potential drivers for inertial confinement fusion (ICF). The efficiency with which the deposited energy in large KrF lasers can be extracted by a saturating photon flux is strongly influenced by the ratio of gain to loss in the amplifier. They have undertaken to measure the absorption in purenoble gasses as a first step in improving the model investigating only a single noble gas. e.g. argon or krypton, affords a much simpler kinetics picture that allows for a more precise benchmark of the model than is usually obtained in laser experiments involving a gas mix of Ar, Kr, and F_2.

52917 Effect of volumetric ASE on the performance of large KrF amplifiers. Czuchlewski, S.J. (Los Alamos National Lab., NM (USA)); Leland, W.T.; Kircher, M.J.; Greene, D.P.; Oertel, J.A.; Romero, V.O.; Steele, H.S. pp. 443 of OSA conference on lasers and electro-optics (1989 Technical Digest series). Optical Society of America, Washington, DC (1989). (CONF-890423–: CLEO '89: conference on lasers and electro optics, Baltimore, MD (USA), 24-28 Apr 1989).

Technical Paper THP2.

The design of large KrF laser systems for breakeven ICF is tending toward the use of a small number of very large final amplifiers. To study the effect of volumetric ASE on such large amplifiers, a new computer model has been developed at Los Alamos National Laboratory. Parameters in this model are the small signal gain, gain to loss ratio, saturation intensity, wall reflectivity, and amplifier dimensions. In this work the effect of ASE on the predict performance of large amplifiers is presented. To benchmark this model, measurements were made of the small signal gain in the large aperture module (LAM) of the Aurora KrF laser system. Gain measurements were made in three different conditions inside the amplifier. In addition to the gain measurements, quantitative sidelight and small cavity, extraction measurements were made on the LAM in the same conditions. Details of these measurements as well as comparisons with the model predictions are presented.

52918 Effect of period gain in continuous-wave (Al,Ga)As epitaxial surface-emitting lasers. Gourley, P.L. (Sandia National Labs., Albuquerque, NM (USA)); Brennan, T.M.; Hammons, B.E.; Corzine, S.W.; Geels, R.S.; Yan, R.H.; Scott, J.W.; Coldren, L.A. pp. 443 of OSA conference on lasers and electro-optics (1989 Technical Digest series). Optical Society of America, Washington, DC (1989). (CONF-890423–: CLEO '89: conference on lasers and electro optics, Baltimore, MD (USA), 24-28 Apr 1989).

Technical Paper FC3.

Epitaxial surface-emitting lasers (ESELs) can be formed with two semiconductor multilayer mirrors surrounding an active region. The active region can have composition modulation with halfwavelength periodicity. This confers significant advantages over conventional edge-emitting lasers. By growing confining wells with halfwave periodicity, carriers can be confined in regions corresponding to maxima in the resonating wave. Thus the laser gain can be tailored layer by layer during growth, and the gain per unit length of lasing material can be increased. ESEL structures were grown by MBE on a (100) GaAs substrate.

52919 Status of rf linac free electron lasers. Warren, R.W. (Los Alamos National Lab., NM (USA)). pp. 443 of OSA conference on lasers and electro-optics (1989 Technical Digest series). Optical Society of America, Washington, DC (1989). (CONF-890423–: CLEO '89: conference on lasers and electro optics, Baltimore, MD (USA), 24-28 Apr 1989).

Technical Paper JM2.

Free electron lasers have passed through three stages in their development: the initial exploratory phase in which different kinds of free electron laser and their accelerators were built and operated, their technical problems addressed, and a preliminary understanding of the physics issues established. In the second phase, recently completed careful experiments were performed with better characterized machines in which most of the important physics issues governing their performance were examined in detail. In the third phase, machines of various sizes are being built, mostly to satisfy the needs of user groups that want to take advantage of the special

properties of the light generated by these machines for various military, industrial, medical, or scientific purposes. The authors briefly address the high points of phase 1 and also the highlights of phase 3. This article focuses on the interesting experiments recently conducted in phase 2. Most of these experiments were performed with the Mark III accelerator at Stanford University, the superconducting accelerator also at Stanford University, or the conventional linac at Los Alamos National Laboratory.

52920 **Ultranarrow bandwidth VUV-XUV laser system.** Cromwell, E. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, and Department of Chemistry, University of California, Berkeley, California 94720 (US)); Trickl, T.; Lee, Y.T.; Kung, A.H. *Review of Scientific Instruments (USA)*, 60(9): 2888-2892 (Sep 1989). DOE Contract AC03-76SF00098.

An ultrahigh-brightness laser system has been developed to study the spectroscopy and dynamics of molecules and clusters in the vacuum ultraviolet (VUV) extreme ultraviolet (XUV) spectral region. The laser utilizes pulse amplification of a single-mode ring dye laser, frequency doubling, and four-wave mixing in a pulsed jet. Pulse energies of >100 mJ in the visible and $>10^{11}$ photons/pulse in the VUV-XUV have been obtained. The bandwidth of the laser has been measured to be 91 MHz in the visible and 210 MHz in the XUV.

52921 **Intracavity multipass system for generation of high flux of cw visible light.** Anheier, N.C. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332-0430 (US)); Labiche, M.J.; Graff, M.M. *Review of Scientific Instruments (USA)*, 60(9): 3080-3081 (Sep 1989).

We describe an intracavity multipass system (IMS) for producing very high cw flux of visible light with ion lasers. Multiple crossings of an ion beam with the extended cavity of an argon-ion laser produce effective photodetachment laser powers well over 1 kW when a high-reflectance output coupler is used. Several IMS configurations have been implemented successfully.

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Refer also to citation(s) 52142, 52204, 52287, 52511, 52575, 52849, 52951, 52952, 53172, 53175

52922 (AERE-R–13417) **Further LDA studies of liquid flow in a partially-blocked rod bundle.** Bosley, R.B.; Negus, C.R. UKAEA Harwell Lab. (UK). Engineering Science Div. Feb 1989. 28p. Available from H.M. Stationery Office, London, price Pound 8.00.

Further LDA studies and computations using the SABRE code have been carried out to understand, and if possible to reduce, the difference between the predicted and measured flow rates in a simulated fast-reactor rod bundle with partial blockage. The windowed test section contained an 11 x 12 array of pyrex rods, and trichloroethylene at a controlled temperature for refractive index matching between the windows, liquid and rods. In this way, the longitudinal and transverse fluid flow could be measured anywhere in the rod bundle, subject to non-interference of the laser beams with the window frames. Velocities were usually measured at the subchannel centres, but velocity profiles in the 0.6 mm inter-rod gaps were measured at selected locations. Two distinct types of measurements are reported, either at subchannel centres close to the wall behind the blockage, or additional fine-scale scans to determine the velocity profile at different locations throughout the flow field. The fine-scale scans were to assess the relationship between mean flow and subchannel-centre flow. The SABRE code developed by Winfrith was run on the Harwell computer using different turbulence models, different numerical approximations and various cross-flow resistance terms, as recommended by Winfrith, to get a better match between the calculations and the measurements. Some improvement in the predictions were made. However, the code always under-predicted the length of the re-circulation zone. Differences in the magnitude of the predicted velocity and the measured velocity were largely attributable to the fact that the code predicted the average axial velocity, whilst the measurements were made at a subchannel centre and were more indicative of peak values. (author).

52923 (CEGB-RD/L–3429/R88) **Equations for calculating interfacial drag and shear from void fraction correlations.** Putney, J.M. Central Electricity Research Labs., Leatherhead (UK). Dec 1988. 21p. (PWR/HTWG/P–(88)630). Order Number DE90606750. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Equations are developed for calculating interfacial drag and shear coefficients for dispersed vapour flows from void fraction correlations. The equations have a sound physical basis and lead to physically correct coefficients in all flow situations. (author).

52924 (CNIC–00193) **Two-dimensional analytical model of inverted-annular film boiling.** Hsu Chichun; Yang Yanhua; Cheng Feng. China Nuclear Information Centre, Beijing, BJ (China). Apr 1988. 18p. (In Chinese). Order Number DE90605322. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A two-dimensional two-fluid model is developed to predict the liquid and vapour parameters as well as the surface temperature of a heated tube. Aphysical model with two regions represents inverted-annular film boiling (IAFB) based on author's visual observations. The analytical model is consisted of a set of differential conservation equations together with appropriate closure correlations and solved numerically. Successful comparisons are made between model predictions and Stewart's experimental data. Generally, the model predicts correctly the dependence of wall temperature on liquid subcooling, mass flow rate, pressure and heat flux input. The two dimensional effectness isn't very significant. The initial vapour film thickness doesn't influence the wall temperature predictions very much.

52925 (JAERI-M–89-065) **Study on gas jet with different densities from the surroundings, 1. Numerical study and measurement of mass fraction of argon gas laminar circular jet.** Fumizawa, Motoo; Hishida, Makoto; Kunugi, Tomoaki. Japan Atomic Energy Research Inst., Tokyo (Japan). Jun 1989. 42p. (In Japanese). Order Number DE90709990. Available from NTIS (US Sales Only), PC A03/MF A01.

The objective of the present study is to investigate numerically and experimentally the behavior of the fluid flow and the mass transfer of argon gas (Ar) laminar circular jet discharging into stagnant air along the gravity force. The study is performed to understand the basic features of air ingress phenomena at pipe rupture accident in high temperature gas-cooled reactor. As the result, the followings were obtained in the range of reciprocal Froude number (x-bar/Fr) from 0.5 to 750: (1) The velocity along the jet axis increased because the jet was accelerated by gravity force. (2) In the vicinity of the jet outlet, potential core of Ar jet existed. Beyond the potential core, the mass fraction decreased along the axis because of entrainment and diffusion of air from the surroundings. (3) Mass flux of Ar along the jet axis increased slightly in x-bar/Fr < 200 and decreased in X-bar/Fr > 200. (4) It is characteristic feature of laminar circular jet of two component gases that half-radii of axial velocity, Ar mass fraction and mass flux decreased along the jet axis in x-bar/Fr < 200. (5) Experimental resutls agreed well with those of numerical analyses on both axial and half-radius of Ar mass fraction. (author).

52926 (N–89-23465) **Advances in computational design and analysis of airbreathing popuision systems.** Klineberg, J.M. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1989. 19p. (NASA-TM–101987;E–4689;NAS–1.15:101987;CONF-890940–: 9. international symposium on air breathing engines (ISABE-9), Athens (Greece), 4-9 Sep 1989). Available from NTIS, PC A03/MF A01.

The recent history of propulsion has been marked by efforts to develop computational techniques that can speed up the propulsion design process and produce superior designs. The availability of powerful supercomputers, such as the NASA Numerical Aerodynamic Simulator, and the potential for even higher performance offered by parallel computer architectures, have opened the door to the use of multi-dimensional simulations to study complex physical phenomena in propulsion systems that have previously defied analysis or experimental observation. An overview of several NASA Lewis research efforts is provided that are contributing toward the long-range goal of a numerical test-cell for the integrated, multidisciplinary design, analysis, and optimization of propulsion systems. Specific examples in Internal Computational Fluid Mechanics, Computational Structural Mechanics, Computational Materials Science, and High Performance Computing are cited and described in terms

of current capabilities, technical challenges, and future research directions.

52927 (N–89-24577) **Some characteristics of bypass transition in a heated boundary layer.** Sohn, K.H.; Obrien, J.E.; Reshotko, E. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1989. 8p. (NASA-TM–102126;E–4912;NAS–1.15:102126;CONF-8908163–: 7. symposium on turbulent shear flows, Stanford, CA (USA), 21-23 Aug 1989). Available from NTIS, PC A02/MF A01.

Experimental measurements of both mean and conditionally sampled characteristics of laminar, transitional and low Reynolds number turbulent boundary layers on a heated flat plate are presented. Measurements were obtained in air over a range of freestream turbulence intensities from 0.3 percent to 6 percent with a freestream velocity of 30.5 m/s and zero pressure gradient. Conditional sampling performed in the transitional boundary layers indicate the existence of a near-wall drop in intermittency, especially pronounced at low intermittencies. Nonturbulent intervals were observed to possess large levels of low-frequency unsteadiness, and turbulent intervals had peak intensities as much as 50 percent higher than were measured at fully turbulent stations. Heat transfer results were consistent with results of previous researchers and Reynolds analogy factors were found to be well predicted by laminar and turbulent correlations which accounted for unheated starting length. A small dependence of the turbulent Reynolds analogy factors on freestream turbulence level was observed. Laminar boundary layer spectra indicated selective amplification of unstable frequencies. These instabilities appear to play a dominant role in the transition process only for the lowest freestream turbulence level studied, however.

52928 (N–89-25078) **Initial characterization of a modular heat exchanger with an integral heat pipe.** Schreiber, J.G. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1989. 8p. (NASA-TM–102097;E–4859;NAS–1.15:102097;CONF-890815–: 24. intersociety energy conversion engineering conference, Arlington, VA (USA), 6-11 Aug 1989). Available from NTIS, PC A02/MF A01.

As part of the Civil Space Technology Initiative (CSTI) Advanced Technology program, a conceptual design of the Stirling space engine (SSE) was generated. The overall goal of the CSTI high capacity power element is to develop the technology base needed to meet the long duration, high capacity power requirements for future NASA space missions. The free-piston Stirling engine (FPSE) was chosen as the growth option in the CSTI program. A major goal during the conceptual design of the SSE was to reduce the number of critical joints. One area of concern was the heat exchanger assemblies that typically have the majority of critical joints. The solution proposed in the SSE conceptual design used 40 modular heat exchangers. Each module has its own integral heat pipe to transport heat from the heat source to the engine. A demonstration of the modular concept was undertaken before committing to the detailed design of the SSE heat exchangers. An existing FPSE was modified as a test bed for modular heat exchanger evaluation. The engine incorporated three heat exchanger modules, each having a sodium filled heat pipe. The thermal loading of these modules was intended to be similar to the conditions projected for the SSE modules. The engine was assembled and tests are underway. The design and fabrication of the heat exchanger modules and the engine used for these tests were described. Evaluation of the individual heat pipes before installation in the engine is described. The initial test results with the modules in operation on the engine were presented. Future tests involving the engine were outlined.

52929 (PB–89-868194/XAB) **Heat pipes. August 1985-July 1989 (Citations from the NTIS data base). Report for August 1985-July 1989.** National Technical Information Service, Springfield, VA (USA). Aug 1989. 70p. Available from NTISPC N01/MF N01.

Supersedes PB–87-864963.

This bibliography contains citations concerning the theory, design, fabrication, testing, and operation of heat pipes. Applications include heat-rejection devices in spacecraft, utilization in passive solar-heating systems and warm air furnaces, and electronic circuit cooling. Heat-recovery operations, and materials considerations are also discussed. (This updated bibliography contains 119 citations, 20 of which are new entries to the previous edition.)

52930 **Compton scatter tomography and its inversion using a few projections.** Bodette, D.E.; Jacobs, A.M. *Transactions of the American Nuclear Society (USA),* 56: 260-261 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Compton scatter tomography utilizes the electronic collimation characteristics available through the Compton scattering angle-energy correlation to obtain tomographic images. In this work we present particular aspects of the technique, which are relevant to the inverse radiation transport problem of reducing marginal projection data to radial two-phase flow regime maps. The results indicate a viable technique for the tomographic imaging of tow-phase flow using practical source strengths and reasonably few detectors.

52931 **Sensitivity studies involving filter functions in the tomographic reconstruction of two-phase flow density distributions.** Arora, P.; Munshi, P.; Rathore, R.K.S. *Transactions of the American Nuclear Society (USA),* 56: 261-263 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The tomographic reconstruction of the density distribution in two-phase flows has been reported by Rathore et al. Those methods were designed for radially symmetric flow situations. For general nonsymmetric density distributions, the backprojection algorithms in medical imaging can be successfully applied after suitable filtering of the projection data. The results reported by Munshi et al. involve a sensitivity study of various filters used in the tomographic reconstruction of two-phase air/water flow. In that study the cross-sectionally averaged values were compared extensively for two different algorithms incorporating several types of filters. The present work involves a sensitivity study of the point-density values reconstructed by the popular filtered-backprojection method summarized by Lewitt. The test are carried out on some assumed distributions of the absorption coefficient μ, which is related to the density ρ in a calibrated sense. The test functions represent bubbly and annular flows. After the initial testing, the air/water flow data were processed to obtain density maps (using appropriate calibration of p versus μ) for various cases of cross-sectionally averaged density $<\rho>$. The reconstructed average density $<\rho>_{CT}$ it comparable to the earlier method.

52932 **Extrapolation of critical Rayleigh values using static nodal integral methods.** Wilson, G.L.; Rydin, R.A. *Transactions of the American Nuclear Society (USA),* 56: 284-285 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The Benard problem is the study of the convective motion of a fluid in a rectangular cavity that is uniformly heated form below. Flow bifurcation in the cavity is a function of the Rayleigh number (Ra). The time-dependent nodal integral method (TDNIM) has been reported previously; its development leads to a set of 11 equations per node. The static nodal integral method (SNIM) was derived from the TDNIM by forcing the dependent variable at adjacent time steps (one of the velocity components or temperature) to take on the node integral average value. The paper summarizes the SNIM calculation of Ra for mesh sizes ranging from 4 x 4 to 24 x 24. The numerical calculation of Ra is within plus or minus one-half unit. The relative errors are calculated based on the obtained extrapolated value of Ra_{best}^{*} = 2584. The paper also summarizes three-point schemes used with increasingly finer mesh combinations. This approach avoids the contamination of the results with a coarse mesh; however, the calculation on n is very sensitive to small changes in the numerical values obtained for Ra^{*}. In this approach, the extrapolated values quickly converge to Ra^{*}_{∞} between 2583 and 2584 with n ≈2.0 as desired, and give a best value of Ra^{*}_{best} = 2584.

4205 Materials Testing

Refer also to citation(s) 52156, 52164, 52662, 53066, 53105

52933 (AD-A–209008/2/XAB) **Solid lubrication studied by optical means. Final report, 1 March 1986-28 February 1989.** Lauer, J.L. Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of

Mechanical Engineering. 31 Mar 1989. 22p. Available from NTIS, PC A03/MF A01.

The well-known and unwelcome phenomenon of the formation of carbon or coke on the surfaces of some clay and clay-supported transition metal cracking and dehydrogenation catalysts used in petroleum refining was applied to develope a process for the lubrication of tribo-surfaces at high temperatures by continuously regenerated surface carbon derived from flow of ethylene gas. Measurements with a pin-on-disc tribometer showed an immediate reduction of friction (from as high as 0.6 to as low as 0.05) and wear for nickel, palladium, ceramics coated with these metals, and for bare silicon carbide and nitride at temperatures between 400 and 650 C and 0.2 MPa average Hertzian pressures, as soon as ethylene was introduced into the conjunction region. The environment could be air under ambient conditions. The carbon deposits were analyzed by Auger and Raman spectroscopy and ellipsometry and found to be generally about 400 A thick and microcrystalline graphite or vitreous.

52934 (AD-A–209275/7/XAB) **Tribology of undulated surfaces. Final report, 1 February 1986-31 January 1989.** Saka, N.; Tian, H.; Oktay, T.; Kim, D.E. Massachusetts Inst. of Tech., Cambridge, MA (USA). Lab. for Mfg. and Productivity. 30 May 1989. 122p. Available from NTIS, PC A06/MF A01.

The objective of this research was to investigate the friction, wear and lubrication characteristics of undulating metallic surfaces. Both dry and lubricated sliding experiments were conducted to evaluate the tribological behavior of metallic surfaces. In addition, analytical studies have been carried out on the friction and wear behavior of the undulated surfaces, and practical applications of the undulated surfaces have also been explored.

52935 (CONF-8908160–2) **Eddy-current inspection of shuttle heat exchanger tube welds.** Dodd, C.V.; Scott, G.W.; Chitwood, L.D. Oak Ridge National Lab., TN (USA). [1989]. 17p. Sponsored by U.S. DOE Energy Research; National Aeronautics and Space Administration. DOE Contract AC05-84OR21400. From 2. conference on non-destructive evaluation for aerospace requirements; Huntsville, AL (USA); 22-24 Aug 1989. Order Number DE90001335. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This goal of this project was to develop the system necessary to demonstrate in the laboratory that an eddy-current system can inspect the tubes and welds described above, screening for the existence of flaws equal in size to, or larger than, the target flaw. The laboratory system was to include the probe necessary to traverse the tubing, the electronics to drive (i.e., electrically excite) the probe and receive and process signals from it, a data display, data recording and playback devices, and microprocessor software or firmware necessary to operate the system. 5 refs., 9 figs., 2 tabs.

52936 (INIS-mf–12002) **A novel holographic technique for strain and deformation measurement.** Technisch-wissenschaftliche Berichte der Staatlichen Materialpruefungsanstalt, Universitaet Stuttgart. Ettemeyer, A. Stuttgart Univ. (Germany, F.R.). Staatliche Materialpruefungsanstalt. 1988. 133p. (In German). Order Number DE90711230. Available from NTIS (US Sales Only), PC A07/MF A01.

A complete holographic system is presented after a description of the holographic measurement principle and of the fundamentals of three-dimensional deformation and dilatation analysis. The new holographic system permits quasi-simultaneous measurements from three extremely divergent directions. For this purpose, the object is illuminated and observed from each of three perspectives. To avoid perturbing interferences and Moire effects, the laser beam is split up into three beams which are no longer coherent with each other. In this way, three holograms are produced in various sections of a single holographic plate. The holograms for the three measurement directions are evaluated with the help of a computer (Phase-shift method). A picture rectification is effected to compensate for the distortion of the object's perspectives due to diverging directions of observation. The three-dimensional shifting components of the displacement vector are calculated for each point of the object's surface. The expansion of the object's surface is derived from these calculations, by means of differentiation. (orig./HP).

52937 (IPEN-PUB–185) **Neutron radiography in the IEA-R1 reactor.** Pugliesi, R.; Moraes, A.P.V. de; Yamazaki, I.M.; Freitas Acosta, C. de. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Aug 1988. 14p. (In Portuguese). Order Number DE90606775. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Neutronradiography of several materials have been obtained at the IEA-R1 Nuclear Research Reactor (IPEN-CNEN/SP), by means of two conversion techniques: (a) (n, α) at the beam-hole $n^0 3$ where a collimated thermal neutron beam, exposure area 4 cm x 8cm and flux at the sample 10^5 n/s cm^2 is obtained. The film used was the CN-85 cellulose nitrate coated with lithium tetraborate (conversor). The time irradiation of the film was 15 minutes and in following was eteched during 30 minutes in a NaOH(10%) aqueous solution at a constant temperature of 60^0C.; (b) (n,γ) by using an experimental arrangement installed in the botton of the pool of the reactor. The flux of the collimated neutron beam is 10^5 n/s/cm^2 at the sample and the conversion is made by means of a dysprozium sheet. The film used was Kodak T-5. The irradiation and the transfering time was 2 hours and 20 hours respectively. (author).

52938 **The use of adjoint calculations in neutron radiography.** Imel, G.R. *Transactions of the American Nuclear Society (USA),* 56: 257 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The purpose of this paper is to describe the usefulness of the fixed source adjoint calculation for neutron radiography, both in terms of optimization of the beam for certain problems and as an interpretive tool. The calculations described below have been applied at the Neutron Radiography Reactor (NRAD) at Argonne National Laboratory-West. The NRAD reactor is a 250-kW(thermal) TRIGA reactor with two helium-filled, collimated beams. Much of the radiography performed at NRAD is of fuel pins or large test loops containing fuel, which a thermalized beam of neutrons would not be able to penetrate. Thus, the NRAD beams are taken directly from the reactor fuel, yielding a relatively hard spectrum of neutrons; an indium foil is typically used with the man response being from the 1.457-eV resonance of ^{115}In. The indium foil is allowed to decay over photographic film, thus transferring an image. The hardness of the spectrum and the use of a foil with an epithermal resonance have contributed to the usefulness of the fixed source adjoint calculation at NRAD.

4208 Electronic Circuits and Devices

Refer also to citation(s) 52641, 52892, 52893, 53131

52939 (AD-A–209053/8/XAB) **Monolithic MgO:$LiNbO_3$ doubly resonant optical parametric oscillator pumped by a frequency-doubled diode-laser-pumped Nd:YAG laser.** Byer, R.L.; Nabors, C.D.; Kozlovsky, W.J.; Eckardt, R.C. Stanford Univ., CA (USA). Edward L. Ginzton Lab. 1 Jan 1989. 4p. Available from NTIS, PC A02/MF A01.

Pub. in Optics Letters, Vol. 14, No. 1, 66-68(1 Jan 1989).

The authors demonstrated a monolithic MgO:LiNbO3 doubly resonant optical parametric oscillator (OPO) using an all solid-state pump. The pump laser was a single-axial-mode monolithic Nd:YAG nonplanar ring oscillator whose diode-laser pump was modulated at 325 kHz to produce relaxation oscillation spikes to higher peak powers at 1.06 micrometers that were frequency doubled in a resonant cavity to 532 nm. Pump depletions for the OPO output was temperature tuned from 1.01 to 1.13 micrometers, producing single-axial-mode output over much of the range. By changing the voltage applied across the OPO, the output wavelength was scanned as much as 11 nm in 310 V.

52940 (AD-A–209055/3/XAB) **OPO (optical parametric oscillators) performance with a long-pulse-length, single-frequency Nd:YAG laser pump.** Byer, R.L.; Kozlovsky, W.J.; Gustafson, E.K.; Eckardt, R.C. Stanford Univ., CA (USA). Edward L. Ginzton Lab. 1988. 5p. Available from NTIS, PC A02/MF A01.

Pub. in SPIE: Pulsed Single-Frequency Lasers: Technology and Applications, Vol. 912, 50-53(1988).

With the advent of new nonlinear materials and single-frequency pump sources, there is renewed interest in Optical Parametric

Oscillators (OPO's). The authors used a single-mode diode-laser-pumped monolithic Nd:YAG nonplanar ring laser that is both amplified and frequency-doubled, to pump a monolithic MgO:LiNbO3 pulsed singly resonant OPO. Optical parametric oscillators offer wide tunability by using a solid-state nonlinear crystal as the gain medium. Since the parametric gain does not come from atomic or molecular transition, the operating wavelength range is limited only by crystal dispersion, the optical transmission ranges for the pump, signal, and idler. Repeatable, reliable, and damage-free operation of OPO's has been difficult to obtain because the nonlinear nature of the gain has required the use of high-peak-power lasers as the pump sources. The short-pulse-length, high-peak-power lasers that were available for early OPO development had fluctuating spatial and temporal mode properties that were responsible for many problems in OPO operation.

52941 (AD-A-209056/1/XAB) **Efficient monolithic $MgO:LiNbO_3$ singly resonant optical parametric oscillator.** Byer, R.L.; Kozlovsky, W.J.; Gustafson, E.K.; Eckardt, R.C. Stanford Univ., CA (USA). Edward L. Ginzton Lab. Dec 1988. 4p. Available from NTIS, PC A02/MF A01.

Pub. in Optics Letters, Vol. 13, No. 12, 1102-1104(Dec 1988).

The authors operated a monolithic MgO:LiNbO3 singly resonant optical parametric oscillator (OPO) as both a standing-wave and a ring-geometry resonator. The OPO was pumped by the second harmonic of an amplified single-mode diode-laser-pumped Nd:YAG laser. Pump depletions of greater than 60% were observed when pumping four times greater than the 35-W threshold. The OPO out put at the resonant signal tuned with temperature from 834 to 958 nm, while the corresponding idler tuned from 1.47 to 1.2 micrometers. The spectral characteristics of the OPO signal output and the relative merits of a standing wave versus a ring geometry are discussed.

52942 (AD-A-209058/7/XAB) **High-repetition-rate femtosecond dye amplifier using a laser-diode-pumped neodymium:YAG laser.** Zysset, B.; LaGasse, M.J.; Fujimoto, J.G.; Kafka, J.D. Massachusetts Inst. of Tech., Cambridge, MA (USA). Research Lab. of Electronics. 6 Feb 1989. 4p. Available from NTIS, PC A02/MF A01.

Pub. in Applied Physics Letters, Vol. 54, No. 6, 496-498(6 Feb 1989).

A high-repetition-rate femotosecond dye amplifier is demonstrated using a laser-diode-pumped Q-switched Nd:YAG laser. Amplification of wavelength-tunable 300-fs pulses from a synchronously mode-locked rhodamine dye laser is achieved with a saturated gain of 70 and a small gain of 200 at a repetition rate of 800 Hz. Maximum pulse energies of 40 nJ are obtained, and pulse compression to as short as 30 fs is demonstrated.

52943 (AD-A-209148/6/XAB) **Electromigration behavior of ionized cluster-beam-deposited aluminum films on SiO_2.** Hummel, R.E.; Yamada, I. Florida Univ., Gainesville, FL (USA). Dept. of Materials Science and Engineering. 31 Oct 1988. 4p. Available from NTIS, PC A02/MF A01.

Pub. in Applied Physics Letters, Vol. 53, No. 18, 1765-1767(31 Oct 1988).

One of the most important features of thin-film metallization in microelectronic devices is its resistance (or lack of resistance) to damage due to electromigration. This is known to become increasingly important as the size of the interconnections becomes smaller. It is thus of utmost importance to look for materials or deposition methods capable of improving the presently obtained electromigration resistance. One of the parameters that allows an immediate assessment of the time under dc stressing until failure has occurred is the activation energy Q for electromigration which appears in the exponential term of the frequently used Black equation. The deposition method described in this letter seems to substantially increase the activation energy for electromigration of pure A1 films. This appears to be of considerable interest since the electronics industry tends to prefer the continuing usage of aluminum as a base metal without the necessity to switch to other materials.

52944 (AD-A-209201/3/XAB) **Program of basic research for high-power switching and other high-power devices. Final report, 1 September 1985-28 February 1989.** Gundersen, M.A. University of Southern California, Los Angeles, CA (USA). Dept. of Electrical Engineering Electrophysics. 23 May 1989. 10p. Available from NTIS, PC A02/MF A01.

The study of the physics of thyratron-type switches under this contract has led to a new low-pressure glow discharge switch that has a number of features that are desirable for high-power applications. The switch has achieved high stand-off voltage and peak current (70 kA), has very fast current rate of rise, and operates near the glow-to-ar transition in hydrogen and other gases. It appears to have intriguing scaling possibilities. In addition, the author demonstrated a cold, hollow cathode that operates with much higher current densities than dispenser and oxide thermionic cathodes – without forming an arc. Current densities that are about 2 orders of magnitude over heated-cathode current densities – 10,000 A/sq cm vs. 100 A/sq cm – were achieved over cathode areas of approximately 1 sq cm. 20,000-A peak current is readily achieved in a simple, unheated configuration. Finally, in a different area, an optoelectronic bistability in GaP was observed. The bistable mechanism is based on trap filling, and has possible applications to optically integrated devices.

52945 (AD-A-209235/1/XAB) **Electromigration behavior of aluminum films deposited on silicon by ionized cluster beam and other techniques.** Hummel, R.E.; Yamada, I. Florida Univ., Gainesville, FL (USA). Dept. of Materials Science and Engineering. 2 Jan 1989. 4p. Available from NTIS, PC A02/MF A01.

Pub. in Applied Physics Letters, Vol. 54, No. 1, 18-20(2 Jan 1989).

It has been briefly mentioned in the literature that aluminum films deposited on pure silicon by the ionized cluster beam (ICB) technique have a remarkably high resistance against electromigration damage. In other words, these films appear to be less vulnerable to the formation of voids (opens) when a direct current of high density is passed through them. No details have been published so far. However, information on this observation is considered to be potentially important for the electronics industry which has been troubled since the beginning of large-scale integration with electromigration-caused failures in thin-film metallizations. Electromigration experiments were carried out on aluminum thin films which have been deposited on oxide-free silicon by employing the ionized cluster-beam technique as well as other related deposition methods. It has been found that the same high electromigration resistance and film structure is obtained with or without utilizing a nozzled crucible and with or without applying ionization and acceleration voltages during deposition. The conclusions are supported by electromigration lifetime measurements, scanning electron micrographs, optical micrographs, reflective high-energy electron diffraction, and x-ray diffraction.

52946 (AD-A-209415/9/XAB) **Single-filament effusion cell with reduced thermal gradient for molecular beam epitaxy.** Streetman, B.G. Texas Univ., Austin, TX (USA). Microelectronics Research Center. Apr 1989. 4p. Available from NTIS, PC A02/MF A01.

Pub. in Jnl. of Vacuum Science and Technology, Vol. B7, No. 2, 214-216(Mar/Apr 1989).

A molecular-beam source utilizing single-filament construction to generate a reproducible and uniform beam of elemental molecules is presented. The filament design is constructed to conform to the shape of pyrolytic boron nitride crucibles utilized in molecular-beam epitaxy (MBE) systems, and to minimize the thermal gradient between the crucible opening and the crucible bottom which is inherent in Knudsen-cell technology. The design also improves heat transfer, efficiency, and flux response of the cell. It is shown that this cell exhibits a better flux response than typical commercially available effusion cells and successfully prevents source material redistribution, thus providing for long-term flux stability and reproducibility in certain materials used in MBE. No increase in background impurity concentration in epitaxial AlGaAs films was observed, when compared to films grown using a standard Varian effusion cell. This cell is currently installed and being used as an aluminum source in a Varian GEN II system.

52947 (AD-A-209430/8/XAB) **Optical and structural properties of molecular-beam epitaxial GaAs on sapphire.** Chin, A.; Bhattacharya, P.; Chang, K.H.; Biswas, D. Michigan Univ., Ann Arbor, MI (USA). Solid-State Electronics Lab. Apr 1989. 7p. Available from NTIS, PC A02/MF A01.

Pub. in Jnl. of Vacuum Science Technology, Vol. B7, No. 2, 283-288(Mar/Apr 1989).

The structural and optical properties of GaAs grown by molecular-beam epitaxy on (0001) and (01$\bar{1}$2)-oriented sapphire substrates are evaluated for possible direct deposition on sapphire optical fibers and optoelectronic device applications. X-ray diffraction studies and cross-sectional transmission electron-microscopy measurements show that the GaAs films are single-crystal and have a (111) orientation for both substrate orientations. Both x-ray and temperature-dependent photoluminescence measurements indicate that the quality of the GaAs films is better for the (01$\bar{1}$2) sapphire orientation. The incorporation of a graded-band-gap strained layer in InGaAs/GaAs superlattice near the sapphire-GaAs interface also improves the optical quality of the GaAs films. Low-temperature photoluminescence spectra is dominated by a peak at 1.49-1.495 eV, with a best linewidth of 26.9 meV, which is due to an integration of several impurity- and defect-related bound-exciton transitions. A peak-to-lower energies by about 60 meV is thought to be due to acceptor-like impurity defect complexes. Post-growth short-term halogen lamp annealing marginally improves the overall luminescence intensity of the samples. A linewidth of 20 meV is measured for a (80 A) GaAs/(120A)Al(0.3)Ga(0.7)As multiquantum grown on sapphire. It is apparent that device-quality single-crystal GaAs and GaAs-related compounds can be deposited directly on sapphire substrates by molecular beam epitaxy, using special growth techniques.

52948 (BNL–43328) **A versatile stepping motor controller for systems with many motors.** Feng, S.K.; Siddons, D.P. Brookhaven National Lab., Upton, NY (USA). [1989]. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890802–8: 7. synchrotron radiation instrumentation (SRI) national conference, Berkeley, CA (USA), 6-10 Aug 1989). Order Number DE90001556. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A versatile system for controlling beamlines or complex experimental setups is described. The system as currently configured can control up to 32 motors, with all motors capable of full speed operation concurrently. There are 2 limit switch inputs for each motor, and a further input to accept a reference position marker. The motors can be controlled via a front panel keyboard with display, or by a host computer over an IEEE-488 interface. Both methods can be used together if required. There is an "emergency stop" key on the front panel keyboard to stop the motion of all motors without losing track of the motors' position. 3 refs., 4 figs., 1 tab.

52949 (CONF-891087–4) **Integrating and enhancing tools for ASIC [application-specific integrated circuits] design using MOSIS [Metal Oxide Semiconductor Implementation Service] fabrication.** Newport, D.F.; Britton, C.L. Jr.; Alley, G.T.; Bryan, W.L.; Emery, M.S.; Ericson, M.N.; Brashear, H.R.; Bouldin, D.W. Oak Ridge National Lab., TN (USA). 1989. 5p. Sponsored by U.S. Department of Defense. DOE Contract AC05-84OR21400. From IEEE nuclear science symposium and exhibits; San Francisco, CA (USA); 25-27 Oct 1989. Order Number DE90001601. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Application-specific integrated circuits (ASICs), which have traditionally been cost-effective only for high volume applications, can now be designed using high quality, inexpensive tools and can be fabricated in small quantities using MOSIS (Metal Oxide Semiconductor Implementation Service). Numerous computer-aided design tools developed under government sponsorship are available to organizations within the United States for just a media handling fee (typically about $200 each). The tool integration and enhancement activities described in this paper have resulted in a proven set of high quality aids that permit the design of custom and semicustom analog and digital ASICs. Examples of projects implemented using this tool set are given along with the support activities that are being conducted to transfer this technology to other federal agencies and universities. 13 refs.

52950 (CONF-891087–5) **Characteristics of CMOS analog integrated structures using MOSIS [Metal Oxide Semiconductor Implementation System].** Britton, C.L. Jr.; Rochelle, J.M.; Alley, G.T.; Newport, D.F.; Bryan, W.L.; Ericson, M.N. Oak Ridge National Lab., TN (USA). 1989. 7p. Sponsored by U.S. Department of Defense. DOE Contract AC05-84OR21400. From IEEE nuclear science symposium and exhibits; San Francisco, CA (USA); 25-27 Oct 1989. Order Number DE90001630. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The performance of analog functions and subcircuits designed at Oak Ridge National Laboratory (ORNL) and successfully implemented using MOSIS fabrication is summarized. Among the topics discussed are operational amplifiers, a low-voltage comparator, solar cells, an improved low-voltage bilateral analog switch a subthreshold reference circuit for supply independent biasing, and a variety of CMOS transistor measurements. The suitability of MOSIS SPICE parameters in strong and weak inversion modeling as well as dc, ac, and noise performance are discussed. Finally, the application to analog design of low-cost, high-performance CAD tools, such as MAGIC, is examined. 7 refs., 11 figs., 1 tab.

52951 (ETDE-IT–89-12) **Two phase cooling of large-diameter power thyristors.** Bordignon, P.; Latrofa, E.; Casarosa, C.; Martorano, L. Ansaldo S.p.A., Genoa (Italy); Pisa Univ. (Italy). 1985. 7p. (CONF-8510512–1: 1. European conference on power electronics and applications, Bruxelles (Belgium), 16-18 Oct 1985). Order Number DE89793129. Available from NTIS (US Sales Only), PC A02.

The paper reports on the technical aspects and performance of a new cooling system based on two-phase, free-convection, heat transfer of dielectric liquids. The new technology, which foresees the immersion of the electronic subassemblies in the liquid pool or, alternatively, the use of a cooling block, takes advantage of the two-phase thermosyphon principle. This permits the full utilization of the current handling capability of thyristors with large silicon wafer diameters. An external air cooling solution is maintained which allows a very compact design. In the near future, it is planned to adopt this cooling method in low- and medium-voltage large power converters (for example, for AC and DC drives and static VAR compensators).

52952 (ETDE-IT–89-14) **Two-phase thermosyphon device for the large thyristor cooling.** Bordignon, P.; Ragni, A.; Latrofa, E.; Casarosa, C. Ansaldo S.p.A., Genoa (Italy); Pisa Univ. (Italy). [1989]. 7p. (CONF-8804156–1: 19. annual IEEE power electronics specialists conference, Kyoto (Japan), 11-14 Apr 1988). Order Number DE89793134. Available from NTIS (US Sales Only), PC A02.

The paper reports on the design of a new advanced air-cooled heat sink device for the cooling of large thyristors, with silicon wafers (75 and 100 mm diameters) and their dissipating auxiliary components, such as snubber resistors. This device, consisting of an evaporator in contact with the power component, adiabatic section and condenser-convective radiator, takes advantage of the two-phase thermosyphon principle and is designed for forced air cooling. The good results obtained from tests of a few samples indicated that this new air cooling technology is suitable to obtain the thermal control of also the largest thyristors, guaranteeing the full utilization of their current-handling capability.

52953 (ETDE-IT–89-22) **Water-cooling system for high-voltage thyristor valves.** Bordignon, P.; Paolin, F. Ansaldo S.p.A., Genoa (Italy). Jul 1986. 9p. (CONF-860903–4: IEEE-Industry Applications Society annual meeting, Denver, CO (USA), 28 Sep - 2 oct 1986). Order Number DE89793140. Available from NTIS (US Sales Only), PC A02.

This paper reports on the design and testing of a direct water-cooling system for high-voltage thyristor valves for synchronous generator starting equipment and static VAR compensation systems. Accelerated aging tests (dielectric and thermomechanical), carried out for more than one year on a prototype thyristor valve, have provided experience on reliability of fine water circuits, on metallic parts (heat sinks, fittings), electrolytic corrosion, and on long term behavior of insulating pipes. The good results obtained to date, indicate that properly engineered water cooling systems can be very reliable and therefore very attractive for high voltage power conversion equipment.

52954 (LBL–26140) **The influence of residual contamination on the structure and properties of metal/GaAs interfaces.** Liliental-Weber, Z. Lawrence Berkeley Lab., CA (USA). Oct 1988. 14p. Sponsored by U.S. Department of Defense; U.S. DOE Energy Research. DOE Contract AC03-76SF00098. N00014-86-K-0668.

(CONF-8811270–1: Workshop of the International School of Materials Science and Technology, Erice (Italy), 2-7 Nov 1988). Order Number DE90000549. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This study shows that interface morphology, orientation relationship, and formation of new phases strongly depend on the surface preparation of GaAs before metal deposition and/or on the annealing environment. The metals investigated (Au, Ag, and Al, with lattice parameters close to each other) deposited in situ on a UHV-cleaved GaAs surface show very similar relationships with GaAs upon annealing. This relationship changes when GaAs is exposed to air before metal deposition. All metals investigated, when deposited on UHV-cleaved GaAs substrate, are stable upon annealing. The interface between metal and GaAs remains abrupt upon annealing. In the case of Cr almost perfect matching to GaAs was observed for UHV deposited samples, but random orientation for air-exposed samples. This study shows that impurities at the semiconductor surface can affect the stability of the barrier height of Schottky contacts. These changes in barrier height depend on the metal used, and on the intensity and direction of the potential and current during the electrical aging. The dramatic example of Ag contacts and their change upon current stressing only for air-exposed samples confirms the importance of surface preparation before metalization. 34 refs., 7 figs., 1 tab.

52955 (SAND–89-1976C) **Low cost simulator for strategic radiation environments.** Browning, J.S. Sandia National Labs., Albuquerque, NM (USA). 1989. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890994–1: Simulation fidelity workshop III, Colorado Springs, CO (USA), 19-21 Sep 1989). Order Number DE90001384. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Recent experimental works on the effect of dose rate on the total dose failure threshold of MOS devices have shown that the failure level is strategic environments may be less than the failure level measured in the laboratory by a factor of 3 to 10. This difference in dose rate response raises concerns about using laboratory sources to predict the radiation hardness in strategic environments. A solution to the problem of determining the total dose hardness of piece parts is to perform lot acceptance testing at relevant dose rates such that the time dependent effects can be directly observed. A low cost method of measuring the total dose hardness of piece parts in the laboratory at requisite dose rates is presented. 11 refs., 5 figs.

52956 (SAND–89-2158) **CMOS ASIC [application specific integrated circuit].** Nuckolls, L.R. Sandia National Labs., Albuquerque, NM (USA). Jul 1989. 38p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE90001866. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper discusses the following topics: semicustom integrated circuits; radiation effects and hardness; circuit design considerations; the design cycle; fault analysis and design for test; and circuit layout.

52957 **Dielectric liquids for possible use in pulsed power switches.** Christophorou, L.G. (Atomic, Molecular, and High Voltage Physics Group, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831 (US)); Faidas, H. *Applied Physics Letters (USA),* 55(10): 948-950 (4 Sep 1989). DOE Contract AC05-84OR21400;AS05-76ER03956.

Dielectric liquids for possible use as (opening/closing) switching materials in pulsed power technology are identified. A concept for a dielectric-liquid-pulsed-power switch employing flashlamps is outlined.

52958 **Simulation of the switching performance of an optically triggered pseudo-spark thyratron.** Pak, H. (University of Illinois, Department of Electrical and Computer Engineering, Gaseous Electronics Laboratory, 607 East Healey, Champaign, Illinois 61820 (US)); Kushner, M.J. *Journal of Applied Physics (USA),* 66(6): 2325-2331 (15 Sep 1989).

The optically triggered pseudo-spark, also known as the back-lit thyratron, is a low-pressure plasma switch having an unheated metallic cathode, which has performance specifications competitive with conventional hot cathode thyratrons. In this paper a computer simulation of the BLT is presented. The simulation consists of a 2 1/2 -dimensional time-dependent continuum model for electron and ion transport using the local field approximation. The model includes an external circuit, and the user may specify the type of gas, pressure, geometry, and electrode materials. Predictions for the anode delay time are compared to experiment as a function of pressure (p), cathode-anode spacing (d), and trigger fluence. We find that switch closure depends critically on the formation of a virtual anode in front of the cathode hole by generation of positive space charge, and that the anode delay time decreases with increasing p, trigger fluence d, and cathode hole diameter. We also find switch performance is not well characterized by the pd product as in other plasma switches. Rather, we find these quantities depend separately on p and d in a manner which is a function of the geometry of the cathode.

52959 **Analog circuit for the measurement of phase difference between two noisy sine-wave signals.** Shakkottai, P. (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California 91109 (US)); Kwack, E.Y.; Back, L.H. *Review of Scientific Instruments (USA),* 60(9): 3081-3083 (Sep 1989).

A simple circuit for the measurement of phase difference between two noisy sine waves is described. The circuit locks over a wide range of frequencies and produces an output proportional to the phase difference of signals that vary rather rapidly.

4209 Waste Processing Plants and Equipment

Refer also to citation(s) 52508, 52509

52960 (CONF-8910193–2) **Theory and evidence of economies of scale in the development of waste management systems.** Chang, Shoou-Yuh; Rivera, A.L. Oak Ridge National Lab., TN (USA). 1989. 54p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OR21400. From DOE model conference; Oak Ridge, TN (USA); 2-6 Oct 1989. Order Number DE90000702. Available from NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.

Waste is a cost of doing business. This cost can be considered in terms of the potential adverse health and environmental impacts, or the waste management costs associated with avoiding, minimizing, and controlling those impacts. There is an anticipated increase in the cost of waste management as a result of the increasing requirements for regulatory compliance. To meet the total waste management capacity needs of the organization and the compliance requirements, low-level radioactive, hazardous, and mixed waste management will need demonstrated technologies strategically managed as a technology portfolio. The role of the decision maker is to select the optimum mix of technologies and facilities to provide the waste management capacity needed for the next twenty years. The waste management system resulting from this mix includes multiple small-scale fixed facilities, large-scale centralized facilities, and waste management subcontracts. This study was conducted to examine the theory and evidence of economies of scale in the development of waste management systems as as exploratory research on the economic considerations in the process of technology selection and implementation. 25 refs., 24 figs., 11 tabs.

4210 Combustion Systems

Refer also to citation(s) 51649, 51699, 52037, 52848, 52864, 52926

52961 (UBA-FB–86-101) **Investigation instigated to develop a reduction method for NO_x-emmission of oil and gas fired steam generators.** Rennert, K.D. Steinmueller (L.U.C.) G.m.b.H., Gummersbach (Germany, F.R.); Umweltbundesamt, Berlin (Germany, F.R.). 1986. 139p. (In German). Contract UFOPLAN-Nr. 10403505/02. Available from Copy held by UB/TIB Hannover.

This report describes the development and testing of a low-NO_x-burner for the combustion of heavy fuel oil and natural gas without a significant increase in carbon carry over or other emittents. The applied reduction technique is a combination of staged combustion and self-induced flue gas recirculation. Measurements taken at hot model test and at a modified industrial boiler show, that a reduction of the NO_x-emission by 30-50% is possible depending on type of fuel and boiler condition. (orig.) With 28 refs., 14 tabs., 64 figs.

52962 **Materials performance of commercial alloys in a simulated FBC environment.** Verma, S.K.; Vesely, E.J. Jr. 11p. National Assoc. of Corrosion Engineers, Houston, TX (1988). (CONF-880314--: Corrosion '88: National Association of Corrosion Engineers meeting, St. Louis, MO (USA), 21-25 Mar 1988).

Technical Paper 88144.

Background information is presented on Fluidized Bed Combustion (FBC) followed by a description of the unique high-temperature high-pressure equipment which has been modified to simulate the operating conditions of the fluidized bed combustor. Results from a 4000 hour exposure of heat-resistant alloys are given, along with summarized conclusions drawn from the 5500 hours of testing done in the program.

52963 **The erosivity of 600σm diameter AFBC bed material.** Levy, A.V.; Shui, Z.R.; Wang, B.Q. 14p. National Assoc. of Corrosion Engineers, Houston, TX (1988). (CONF-880314--: Corrosion '88: National Association of Corrosion Engineers meeting, St. Louis, MO (USA), 21-25 Mar 1988).

Technical Paper 88145.

The erosivity of the bed material particles from the Pt. Tupper AFBC were studied in a laboratory erosion-corrosion tester. As-received particles of 600μm dia were tested at velocities and temperatures somewhat higher than those that occur in actual FBC's. It was determined that the larger size bed material particles were generally more erosive than smaller Al_2O_3 and SiC particles used in earlier tests. Under all test conditions a segmented scale formed on the base metal and was removed by a cracking and chipping mechanism.

4220 Underground Engineering

Refer also to citation(s) 52872

4240 Pollution Control Equipment

Refer also to citation(s) 51678, 51679, 52153

52964 (PB–89-198360/XAB) **Wind-tunnel measurements of the collection efficiency of two PM10 samplers: The Sierra-Andersen Model 321A hi-volume sampler and the EPA (Environmental Protection Agency) prototype dichotomous sampler. Report for August 1987-June 1988.** Hall, D.J.; Upton, S.L.; Marsland, G.W.; Waters, R.A. Warren Spring Lab., Stevenage (UK). 1988. 52p. (LR–669(PA)M). Available from NTIS, PC EE06/MF E06.

This report describes some wind-tunnel measurements of the collection efficiency of two size-selective PM10 aerosol samplers, the Andersen 321A and the EPA Prototype Dichotomous Sampler, designed to have a particle size cut-off at 10 micrometers in the form satisfying the final regulations recently promulgated by the United States Environmental Protection Agency. Part of the regulations concern wind-tunnel testing of the collection efficiency of samplers, following a standard procedure, in order to determine their performance at different windspeeds and particle diameters. Both the test procedure and the performance of samplers (particularly that of the Andersen 321A sampler at high wind speeds) have been a matter of recent discussion. This work used different test procedures to those laid down by the EPA, developed independently in order to satisfy European needs for aerosol sampler testing. The measurements covered the full range of wind speeds required by the EPA, 2, 8 and 24km h-1, and used liquid droplets in the range 3 to 20 micrometers.

52965 (PB–89-207252/XAB) **Modeling particulate charging in ESPs (electrostatic precipitators).** Lawless, P.A.; Sparks, L.E. Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab. 1988. 8p. (EPA–600/J-88/312). Available from NTIS, PC A02/MF A01.

Pub. in IEEE (Institute of Electrical and Electronics Engineers) Transactions on Industry Applications, Vol. 24, No. 5, 922-927(Sep/Oct 1988).

This article proposes a method to calculate both the space charge and the operating point of electrostatic precipitators (ESPs). In ESPs, there is a strong interaction between the particulate space charge and the operating voltage and current of an electrical section. Calculating either when the other is fixed is not difficult, but calculating both self-consistently is much more difficult. An iterative solution is required, but the closure rate should be acceptable.

43 PARTICLE ACCELERATORS

52966 (CERN–89-07) **Introduction to particle accelerators.** Germain, P. European Organization for Nuclear Research, Geneva (Switzerland). 7 Jul 1989. 118p. (In French). Order Number DE90606758. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

In this course of introduction to particle accelerators, the main aim is to give an overall view of the different types currently in service, particularly those used for experiments in particle physics. Emphasis is also placed on the principles of operation, together with the advantages and disadvantages of each type of machine. The theoretical treatment is limited to the case of circular accelerators, these being the most common in actual use, and the treatment is simplified by neglecting space-charge and wall effects. (orig.).

52967 (UCRL–53889-88) **Beam research technical abstracts, 1988.** Henry, A.L. (ed.). Lawrence Livermore National Lab., CA (USA). Jul 1989. 66p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90000974. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This document is a summary of the published unclassified scientific work of the Beam Research Program at Lawrence Livermore National Laboratory during the calendar year 1988. It includes the complete abstract of each report as well as three indexes: author, key word, and report number.

4301 Design, Development, and Operation

Refer also to citation(s) 51946, 51947, 51979, 52008, 52009, 52014, 52919, 53047, 53669, 53684, 54025

52968 (BNL–41797-Rev.) **Operational status of the Brookhaven National Laboratory Accelerator Test Facility: Revision.** Batchelor, K.; Ben-Zvi, I.; Chou, T.S.; Fernow, R.C.; Fischer, J.; Gallarado, J.; Kirk, H.G.; Palmer, R.B.; Pellegrini, C.; Sheehan, J.; Srinivasan-Rao, T.; Ulc, S.; Van Steenbergen, A.; Woodle, M.; Biglio, I.; Kurnit, N.; McDonald, K.T. Brookhaven National Lab., Upton, NY (USA). [1989]. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890335–257: 13. particle accelerator conference, Chicago, IL (USA), 20-23 Mar 1989). Order Number DE90001546. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Design and operation of a 50 MeV Electron Linear Accelerator utilizing a low emittance ($\gamma\ \varepsilon$ = 5 to 10 mm-mrad) radio frequency gun operating at an output energy of 5 MeV and a charge of 1 nC is described. Design calculations and early radio frequency measurements and operational experience with the electron gun utilizing a dummy copper cathode in place of the proposed photocathode emitter are given. 6 refs., 9 figs., 1 tab.

52969 (CRN-VIV–57) **Vivitron: the injector, the terminal and the beam transfer to the actual lines. Situation as of September 30, 1988.** Rebmeister, R. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. Sep 1988. 15p. (In French). Order Number DE90713799. Available from NTIS (US Sales Only), PC A03/MF A01.

The status of the work done for the project Vivitron as of September 88 is shown. Beam injection, the terminal, Faraday cups, vertical steering, and beam transfer are covered.

52970 (DOE/ER/40048–229-L9) **Status of and operating experience with the University of Washington superconducting booster linac.** Storm, D.W.; Amsbaugh, J.F.; Corcoran, D.T.; Harper, G.C.; Howe, M.A.; Stowell, R.E.; Weitkamp, W.G.; Van Wechel, T.D.; Will, D.I. Washington Univ., Seattle, WA (USA). Nuclear Physics Lab. [1989]. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-81ER40048. (CONF-8905141–5: 5. international conference on electrostatic accelerators and associated boosters, Strasbourg (France), 24-27 May 1989). Order

Number DE89017273. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The University of Washington Superconducting Linac uses lead-plated copper quarter-wave resonators for acceleration. These accept a wide range of particle velocities. There are 24 accelerating resonators with β of 0.1 and 12 resonators with β of 0.2, as well as a bunching resonator with β of 0.1 and a rebuncher/debuncher with β of 0.2. These β values are higher than those of other similar machines, reflecting our emphasis on lighter ions. We are able to accelerate ions with masses ranging from one through above 60. The linac has been in operation since September 1987. During the early part of this period of operation various systems were completed and debugged, and during the remaining part of the period we have been running fairly routinely while gaining experience and skill in operation. Following a brief description of the accelerator, the operating experience, techniques, and automatic control features will be described in detail. 14 refs., 3 figs.

52971 (DOE/ER/40150–92) **A beauty factory using an SRF linac and a storage ring.** Bisognano, J.J.; Boyce, J.R.; Douglas, D.; Heifets, S.; Kewisch, J.; Krafft, G.; Rossmanith, R. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. 1988. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84ER40150. (CEBAF-PR–89-017;CONF-881049–80: 14. linear accelerator conference (LINAC-14), Williamsburg, VA (USA), 3-7 Oct 1988). Order Number DE90000766. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

We present a brief review of accelerator facilities proposed for measuring CP violation in the B-meson system. In light of this comparison we discuss requirements for a B-factory using an e^+ storage ring beam colliding with a superconducting RF linac e^- beam to produce a luminosity of 10^{34} $cm^{-2}sec^{-1}$. 14 refs., 3 tabs.

52972 (FNAL/C–89/198) **400-MeV upgrade for the Fermilab linac.** Young, D.E.; Noble, R.J. Fermi National Accelerator Lab., Batavia, IL (USA). Sep 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-890803–29: International conference on high energy accelerators, Tsukuba (Japan), 20-26 Aug 1989). Order Number DE90001573. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Fermilab plans to upgrade the Tevatron to expand the physics research program in both the fixed target and the collider operating modes. The first phase of this program is to increase the energy of the H^- linac from 200 to 400 MeV in order to reduce the incoherent space change tuneshift at injection into the Booster which can limit either the brightness or the total intensity of the beam. The linac upgrade will be achieved by replacing the last four 201 MeV, with seven 805 MHz side-coupled cavity modules operating at an average axial field of about 8 MV/m. This will allow acceleration to 400 MeV in the existing Linac enclosure. 4 refs., 3 figs., 1 tab.

52973 (INIS-mf–12006, pp. 1-6) **Tandem accelerators.** Dorne, G.; Duerr, W.; Heck, R.; Horn, K.; Jaeschke, E.; Kandler, H.; Kraemer, D.; Koessler, V.; Pfahler, R.; Povh, B. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

During its last full year of operation the performance of the EN-Tandem-Accelerator was exceptionally smooth and reliable. Because of rather low voltage stresses - almost all users demanded less than 3 MV - no severe machine failures occurred. The spiral-inclined Ti-acceleration tube still is in excellent condition after more than 48000 hours of operation. Operation of the MP-Tandem suffered from various defects, most of them related to the charging system. Aging effects of plastic minor design errors caused several near-breakages of the chains which were, however, detected in time. Two dramatic failures of turbo-pumps occurred in the ion-source and tube-vacuum systems. Routine operation of the high-intensity sputter source in the pulsed mode for TSR-injections was started with ^{12}C, ^{16}O and ^{7}Li beams. The cathode power-supply was improved and a pulse-current monitor has been built for continuous monitoring of source performance. The former 3 UH negative heavy ion injector of the MP is presently being converted into a positive proton accelerator for PIXE-μ-beam experiments. The terminal ion source equipment is in an advanced state of production, the penning ion source has been tested and is ready for installation. (orig.).

52974 (INIS-mf–12006, pp. 7) **The Heidelberg heavy ion postaccelerator.** Blum, M.; Frauenfeld, M.; Friedrich, A.; Gahn, P.; Grieser, M.; Geyer, C.; Hahn, W.; Hemberger, K.H.; Holzer, B.; Horn, K. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

The Heidelberg Heavy Ion Postaccelerator has been operated in 1988 reliably in many production runs for nuclear physics experiments, as well as in a special chopper mode together with the new storage ring TSR. The beam transport set up during the construction of the TSR proved to be easier to operate showing at the same time better transmission than the one used up to 1987. (orig.).

52975 (INIS-mf–12006, pp. 22) **The source for polarized alkali ions.** Reich, H. (Marburg Univ. (Germany, F.R.). Fachbereich 13 - Physik); Becker, K.; Blatt, K.; Fick, D.; Korsch, W.; Leucker, H.; Luck, W.; Voelk, H.G.; Gerlach, A.; Giroux, J. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

The source for polarized heavy ions (PSI) has been used to produce polarized beams of ^{23}Na for several runs. The method of polarizing an alkali atomic beam by optical pumping with an electrooptic modulated laser was used in all experiments and turned out to be very effective and reliable. (orig.).

52976 (SLAC-PUB–4946) **Nonplanar machines.** Ritson, D. Stanford Linear Accelerator Center, Menlo Park, CA (USA). May 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8910126–2: 3. joint US-CERN school on particle accelerators: frontiers of particle beams, observation, diagnosis, and correction, Capri (Italy), 20-26 Oct 1989). Order Number DE89014592. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

This talk examines methods available to minimize, but never entirely eliminate, degradation of machine performance caused by terrain following. Breaking of planar machine symmetry for engineering convenience and/or monetary savings must be balanced against small performance degradation, and can only be decided on a case-by-case basis. 5 refs.

52977 (SLAC-PUB–5075) **SLC status and SLAC [Stanford Linear Accelerator Center] future plans.** Richter, B. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Aug 1989. 18p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-890803–21: International conference on high energy accelerators, Tsukuba (Japan), 20-26 Aug 1989). Order Number DE90000941. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

In this presentation, I shall discuss the linear collider program at the Stanford Linear Accelerator Center as it is now, and as we hope to see it evolve over the next few years. Of greatest interest to the high energy accelerator physics community gathered here is the development of the linear collider concept, and so I shall concentrate most of this paper on a discussion of the present status and future evolution of the SLC. I will also briefly discuss the research and development program that we are carrying out aimed at the realization of the next generation of high-energy linear colliders. SLAC had a major colliding-beam storage-ring program as well, including present rings and design studies on future high-luminosity projects, but time constraints preclude a discussion of them. 8 figs., 3 tabs.

52978 (UCRL–101066) **Anharmonic betatron motion in free electron lasers.** Barnard, J.J. Lawrence Livermore National Lab., CA (USA). 25 Sep 1989. 19p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-48. (CONF-8908134–6: 11. international free electron laser conference, Naples, FL (USA), 28 Aug - 1 sep 1989). Order Number DE90001515. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We calculate the trajectory of an electron in an FEL, including non-linear, off-axis focusing terms in the transverse equations of motion. We estimate the emittance growth due to the non-linear terms. 6 refs., 5 figs., 1 tab.

52979 **Design and application of a proton therapy accelerator.** Cole, F. (Fermi Nat. Lab., Batavia, IL (US)); Livdahl, P.V.; Mills, F.; Teng, L. pp. 2030 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S IEEE Service Center, Piscataway, NJ (1987). (CONF-870302--: Particle accelerator conference, Washington, DC (USA), 16-19 Mar 1987).

It was pointed out long ago that proton beams are clinically valuable because of their well defined boundaries and the Bragg peaking of their energy deposition in matter at the end of the range. To make a proton therapy facility feasible one must, however, have precise information of the location of the treatment volume and the characteristics of the overlying tissue. It is only within the last decade that new imaging techniques, computed tomography (CT scanning),Magnetic Resonance Imaging (MRI), positron emission tomography (PET) and ultrasound, have been available to give adequate accuracy. Thus the time is now ripe for the construction of a full-time proton therapy facility in a major medical institution. This paper describes the design of the Proton Therapy Facility for the Loma Linda University Medical Center.

52980 **Installation and operation of a new extraction area in the FNAL Booster.** Lackey, J.R. (Fermi Nat. Lab., Batavia, IL (US)); Owen, C.W.; Rice, R.K. pp. 2030 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S IEEE Service Center, Piscataway, NJ (1987). (CONF-870302--: Particle accelerator conference, Washington, DC (USA), 16-19 Mar 1987).

The authors discuss the installation and operation of a new extraction area in the Booster. The primary purpose of this system was to provide protons for commissioning the Antiproton Debuncher and Accumulator. The area also serves during normal operations as a high intensity beam dump for 8 GEV protons not injected into the Main Ring. It permits parasitic Booster studies and the injection of a smaller number of beam bunches into the Main Accelerator for use in the Collider program.

52981 **Plasma behavior in the boundary layer near a railgun surface.** Kang, S.W. (Lawrence Livermore National Lab., CA (USA)); McCallen, R. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics (USA),* 25(1): 277-279 (Jan 1989).

Viscous flow and thermal characteristics are theoretically analyzed for the plasma behind a moving projectile inside a railgun. When only convective effects are included in the turbulent boundary layer analysis, the results suggest a temperature maximum in the wall region for very high velocity flows. The case of radiative as well as convective transport has also been investigated for an optically thick boundary layer flow by application of an approximate method. Results show a sizable effect of radiation on the flow characteristics, especially on the heat transfer rate to the railgun surface.

52982 **Starfire.** Hawke, R.S. (Lawrence Livermore National Lab., CA (USA)); Susoeff, A.R.; Asay, J.R.; Balk, J.K.; Hall, C.A.; Koniad, C.H.; McDonald, M.J.; Schuler, K.W.; Wellman, G.W.; Hickman, R.J. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics (USA),* 25(1): 223-227 (Jan 1989).

STARFIRE, a program based at Sandia National Laboratories, has as its goal the development of a hypervelocity railgun for use as a high-pressure research tool. The program has included efforts to identify and solve the problems that have inhibited reliable attainment of velocities greater than the 8 to 9 km/s attainable with two-stage light-gas guns (2SLGG). Issues studied include: (1) plasma arc formation and stabilization, (2) restrike inhibition, (3) viscous drag, (4) ratio of preload to operating stresses, (5) barrel joint design, and (6) barrel precision requirements. The system uses a 2SLGG as an injector to minimize barrel ablation and armature contamination. Hydrogen is used as the injection gas and will also serve to reduce the probability of forming secondary arcs. A VISAR optical Doppler system is used to continuously and precisely measure the projectile velocity from a standing start in the 2SLGG barrel, through several joints, the HELEOS (Hypervelocity Experimental launcher for Equation of State) railgun barrel, and post-launch. The STARFIRE program is focused on the combined use of precision diagnostics and new experimental techniques. Results of tests are presented.

52983 **Why plasma armature railguns don't work (and what can be done about it).** Parker, J.V. (Los Alamos National Lab., NM (USA)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics (USA),* 25(1): 418-424 (Jan 1989).

Plasma armature railguns have failed to achieve the high velocities predicted in the early 1980's. Only a few experiments in the last decade have exceeded the velocity of 5.9 km/s obtained by Rashleigh and Marshall in their pioneering plasma armature experiments. The apparent barrier at 6 to 7 km/s results from viscous and ablation drag on neutral and ionized material in the railgun bore. It has taken almost five years to understand and demonstrate clearly the interrelation of ablation, viscous drag, and arc restrike. In the light of this improved understanding, it is time to examine the future potential of plasma armature railguns. There is little reason to hope that conventional railguns will exceed a velocity of 8 to 10 km/s. New approaches based on reducing the amount of material entering the bore or eliminating electrical conduction appear promising. Based on current understanding a velocity of 20 to 25 km/s appears possible using either advanced materials or novel railgun power systems.

52984 **The SRS railgun.** Parker, J.V. (Los Alamos National Lab., NM (USA)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics (USA),* 25(1): 412-417 (Jan 1989).

A Segmented Rail Surface (SRS) structure is described that eliminates restrike arcs by progressively disconnecting segments of the rail surface after the plasma armature has passed. This technique has been demonstrated using the Los Alamos MIDI-2 railgun. Restrike was eliminated in a plasma armature acceleration experiment using metal-foil fuses as opening switches. A plasma velocity increase from 11 to 16 km/s was demonstrated using the SRS technique to eliminate the viscous drag losses associated with the restrike plasma. This technique appears to be a practical option for a laboratory launcher at present and for future multi-shot launchers if appropriate switches can be developed.

52985 **Structural consequences of railgun augmentation.** Wellman, G.W. (Sandia National Labs., Albuquerque, NM (USA). Applied Mechanics Div. III); Schuler, K.W. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics (USA),* 25(1): 593-598 (Jan 1989).

An augmented railgun can provide the same driving force on a projectile at a lower plasma arc current and thus less potential erosion and barrel damage as an unaugmented railgun. However, there are structural consequences to railgun augmentation which must be overcome before the advantages of lower plasma arc currents can be realized. To investigate these consequences, a bolted V-block supporting structure is considered with two cores; unaugmented (a single pair of conducting rails), and augmented (conducting rails augmented by a second tandem set of conductors). The mechanical load on the cores consist of the static bolt preload, the plasma pressure behind the projectile, and the magnetic pressure induced by currents flowing in the rails or augmenting conductors. Assuming no current diffusion into the conductors, the magnetic pressure distribution on the conductors is determined by solving the two dimensional magnetostatic field equations using an analogy with heat transfer. These loads are then used in a dynamic finite element structural model. The maximum rail current is found at which the unaugmented railgun can be repetitively fired without detrimental gaps forming at the bore. For the augmented railgun, at the same projectile acceleration, large permanent deformations can occur. Thus successful implementation of rail gun augmentation will require improvement of the supporting structure.

52986 **Fabrication issues and technology development for HELEOS.** Susoeff, A.R. (Lawrence Livermore National Lab., CA (USA)); Hawke, R.S.; Balk, J.K.; Hall, C.A.; McDonald, M.J. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics (USA),* 25(1): 541-545 (Jan 1989).

Starfire is a joint railgun of Lawrence Livermore National Laboratory and Sandia National Laboratory-Albuquerque. The goal of

Starfire is to develop a Hypervelocity Electromagnetic Launcher for Equation of State (HELEOS) experiments. A two-stage light-gas gun is used as a pre-injector. Each round-bore HELEOS railgun module is 12.7 mm in diameter and 2.4 m long. The muzzle end of the railgun is connected to a vacuum tank. Common materials and fabrication technology are used in the manufacture of all components, and modular design allows for extending the length of the railgun as progress dictates. The launcher uses a "vee block" geometry, which is designed to: (1) provide compressive preload, (2) operate with a 300-MPa (3-kbar) internal bore pressure, and (3) easily accommodate interchangeable materials in the bore support structure and rail. The authors have performed full-scale material testing of the railgun and have developed a precision round-bore fabrication process. Air-gage inspection is used to determine bore diameter and straightness. They have also developed a surface mapping system to document the surface topography of the bore before and after an experiment. This paper presents fabrication details, results of tests conducted, and areas for potential improvement.

52987 Use of a two-stage light-gas gun as an injector for electromagnetic railguns. Shahinpoor, M. (New Mexico Univ., Albuquerque, NM (USA). Dept. of Mechanical Engineering); Asay, J.R.; Konrad, C.H.; Hall, C.A. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics (USA),* 25(1): 514-518 (Jan 1989).

Ablation of wall materials is known to be a major factor limiting the performance of railguns. To minimize this effect, it is desirable too inject projectiles into railgun at velocities greater than the ablation threshold velocity (6-8 km/s for copper rails). Because two-stage light-gas guns are capable of achieving such velocities, a program was initiated to design, build and evaluate the performance of a two-stage light gas gun, utilizing hydrogen gas, for use as an injector to an electromagnetic railgun. This effort is part of a project to develop a hypervelocity electromagnetic launcher (HELEOS) for use in equation-of-state studies. In this paper, the specific design features that enhance compatibility of the injector with the railgun, including a slip-joint between the injector launch tube and the coupling section to the railgun are described. The operational capabilities for using all major projectile velocity measuring techniques, such as in-bore pressure gauges, laser and CW x-ray interrupt techniques, flash x-ray and continuous in-bore velocity measurements using VISAR interferometry are also discussed. Finally an internal ballistics code for optimizing gun performance has been utilized to interpret performance data of the gun.

52988 Analytic solutions to dynamic equations of plasma armature railguns. Shahinpoor, M. (New Mexico Univ., Albuquerque, NM (USA). Dept. of Mechanical Engineering); Hawke, R.S. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics (USA),* 25(1): 508-513 (Jan 1989).

General governing nonlinear differential equations pertaining to the dynamic behavior of a plasma armature electromagnetic railgun are first derived. Three different cases are then considered and the corresponding governing equations are then solved exactly by means of a set of nonlinear transformations. These cases correspond to (1) no-ablation, (2) continuous-ablation, and (3) partial-ablation for which an ablation threshold velocity v_{tau} plays a fundamental role. Corresponding to each case, a nonlinear transformation is employed to reduce the nonlinear differential equations to their equivalent linear ones and subsequently allow solution of the pertinent linear differential equations, which are second order, by means of the transition matrix technique. It is concluded that in order to achieve very high projectile velocities the projectile should be injected into the railgun at velocities higher than the ablation threshold velocity. Thus, the ablation may be completely alleviated and the ensuing turbulent drag may be significantly diminished. It is shown that under these conditions one may typically accelerate projectiles up to 30 km/s or more while without hypervelocity injection, for the same railgun and typical operating conditions, one might severely limit the maximum projectile velocity.

4302 Beam Dynamics, Field Calculations, and Ion Optics

Refer also to citation(s) 52915, 53044, 53045, 53057, 53058, 53110

52989 (BNL–42942) **MONO: A program to calculate synchrotron beamline monochromator throughputs.** Chapman, D. Brookhaven National Lab., Upton, NY (USA). [1989]. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890802–9: 7. synchrotron radiation instrumentation (SRI) national conference, Berkeley, CA (USA), 6-10 Aug 1989). Order Number DE90001557. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A set of Fortran programs have been developed to calculate the expected throughput of x-ray monochromators with a filtered synchrotron source and is applicable to bending magnet and wiggler beamlines. These programs calculate the normalized throughput and filtered synchrotron spectrum passed by multiple element, flat un- focussed monochromator crystals of the Bragg or Laue type as a function of incident beam divergence, energy and polarization. The reflected and transmitted beam of each crystal is calculated using the dynamical theory of diffraction. Multiple crystal arrangements in the dispersive and non-dispersive mode are allowed as well as crystal asymmetry and energy or angle offsets. Filters or windows of arbitrary elemental composition may be used to filter the incident synchrotron beam. This program should be useful to predict the intensities available from many beamline configurations as well as assist in the design of new monochromator and analyzer systems. 6 refs., 3 figs.

52990 (BNL–43287) **Longitudinal higher order modes of the booster proton rf cavity loaded with a lossy dispersive ferrite.** Khiari, F.Z.; Luccio, A.U. Brookhaven National Lab., Upton, NY (USA). 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890803–24: International conference on high energy accelerators, Tsukuba (Japan), 20-26 Aug 1989). Order Number DE90001264. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The ferrite coupled longitudinal modes of the AGS Booster rf cavities are calculated and their effect on the beam is estimated. 6 refs., 3 figs., 1 tab.

52991 (BNL–43321) **NSLS [National Synchrotron Light Source] X-19A beamline performance for x-ray absorption measurements.** Yang, C.Y.; Penner-Hahn, J.E.; Stefan, P.M. Brookhaven National Lab., Upton, NY (USA). [1989]. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890802–4: 7. synchrotron radiation instrumentation (SRI) national conference, Berkeley, CA (USA), 6-10 Aug 1989). Order Number DE90001553. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Characterization of the X-19A beamline at the National Synchrotron Light Source (NSLS) is described. The beamline is designed for high resolution x-ray absorption spectroscopy over a wide energy range. All of the beamline optical components are compatible with ultrahigh vacuum (UHV) operation. This permits measurements to be made in a window-less mode, thereby facilitating lower energy (<4 KeV) studies. To upgrade the beamline performance, several possible improvements in instrumentation and practice are discussed to increase photon statistics with an optimum energy resolution, while decreasing the harmonic contamination and noise level. A special effort has been made to improve the stability and UHV compatibility of the monochromator system. Initial x-ray absorption results demonstrate the capabilities of this beamline for x-ray absorption studies of low Z elements (e.g. S) in highly dilute systems. The future use of this beamline for carrying out various x-ray absorption experiments is presented. 10 refs., 4 figs.

52992 (DOE/ER/40150–93) **Requirements for longitudinal HOM damping in superconducting recirculating linacs.** Bisognano, J.J.; Fripp, M.L. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84ER40150. (CEBAF-PR–89-018;CONF-881049–79: 14. linear accelerator conference (LINAC-14), Williamsburg, VA (USA), 3-7 Oct 1988). Order Number DE90000765. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Transverse beam breakup provides the primary current limitation in the operation of superconducting recirculating linacs and requires the significant damping of transverse-deflecting higher order modes.

The need to damp the coexisting longitudinal HOMs in these nominally isochronous machines, however, is not as clear. Isochronicity implies that energy variations induced by excitation of longitudinal modes do not translate directly into position and current modulations. Such modulations, if present, could enhance the initial excitation, effectively closing a potentially unstable feedback loop. Design optimization of cavity structures may suggest that no longitudinal damping be provided. On the other hand, easing of the isochronicity requirement may provide desired flexibility in lattice design. In this note, limits are placed on the requirements for longitudinal HOM damping and on the tolerances for isochronicity which are driven by possible longitudinal multipass phenomena. 2 refs., 1 fig.

52993 (DOE/ER/40150–94) **On using a superconducting linac to drive a short wavelength FEL.** Krafft, G.A.; Bisognano, J.J. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. 1989. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84ER40150. (CEBAF-PR–89-019;CONF-890335–259: 13. particle accelerator conference, Chicago, IL (USA), 20-23 Mar 1989). Order Number DE90000764. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

In order to determine the suitability of using a superconducting radio frequency (SRF) linac to generate XUV radiation, the beam dynamics in such a linac have been simulated using a vectorized two dimensional beam breakup code, TDBBU. The energy spread and emittance of the accelerated beam are determined as a function of current for a linac like CEBAF and for a linac optimized for high peak currents. The results indicate that there are significant improvements in transverse emittance growth possible by going to lower RF frequencies and by utilizing BNS phasing in the accelerating cavities. In the first section of this paper the simulation is described. Next, the transverse and longitudinal wakes typical in superconducting cavities are discussed. The results of the simulations are given, followed by a comparison of a linac driven FEL and a typical storage ring driven FEL. The conclusion of the work is that the former scheme looks promising because higher average power is possible. 4 refs., 6 figs., 3 tabs.

52994 (INIS-mf–12006, pp. 141) **Properties of waves in an ion-beam plasma system.** Zank, G.P. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.)); Naidu, K.; McKenzie, J.F. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

An earlier study of the properties of waves in an ion-beam plasma system is extended to the strongly magnetized regime. The temporal stability and spatial amplification of the slow ion-acoustic mode is investigated. (orig.).

52995 (LBL–25888) **Effects of undulators on the ALS: The early work on the LBL [Lawrence Berkeley Laboratory].** Jackson, A. Lawrence Berkeley Lab., CA (USA). May 1988. 25p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-8805335–1: Workshop on the effects of undulators storage ring dynamics, Berkeley, CA (USA), 17-20 May 1988). Order Number DE90001214. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

In this paper we describe the early work carried out at LBL on the consequences of installing insertion devices (wigglers and undulators) on the beam dynamics of the ALS. This included analytical and tracking studies, and led to an insight to the reasons behind the predicted reduction in dynamic aperture. For completeness, a description of the unperturbed storage ring characteristics are also given. 3 refs., 16 figs., 2 tabs.

52996 (SAND–88-3305C) **Multi-megagauss magnetic field generation on Saturn.** Spielman, R.B.; Hussey, T.W.; Hanson, D.L.; Lopez, S.F. Sandia National Labs., Albuquerque, NM (USA). 1989. 11p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890710–21: 5. international conference on megagauss magnetic field generation and related topics, Novosibirsk (USSR), 3-7 Jul 1989). Order Number DE90001093. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Very large magnetic fields were first produced using electrical discharges through coils. More recently, many researchers have used the method of explosively-driven flux compression to generate megagauss magnetic fields. We reported using Proto-II, a 10 TW electrical accelerator, to directly generate fields up to 1.5 kT (15 MG) in a coaxial geometry. The development of even larger electrical accelerators has now allowed us to directly generate magnetic fields of magnitudes equivalent to the largest values attained with explosively-driven flux compression generators. In this paper we report experimental results in which the Saturn accelerator delivered a peak current of 10.5 MA to a 2-mm diameter tungsten rod, thereby generating a peak magnetic field of ~2.1 kT (21 MG). We also show the results of one-dimensional (1-D) calculations which show that peak fields of 2.1 kT were achieved at the surface of the tungsten rod. We will discuss possible constraints on the production of megagauss magnetic fields by either direct current generation or by explosively-driven flux compression using metallic liners. 16 refs., 11 figs.

52997 (SAND–89-2114C) **New field solver for the buckshot code.** Shokair, I.R.; Wagner, J.S. Sandia National Labs., Albuquerque, NM (USA). [1989]. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8909216–4: DARPA/SDIO service annual charged particle beam review, Monterey, CA (USA), 18-21 Sep 1989). Order Number DE90000804. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Buckshot code is a gridless particle simulation code which is used extensively at Sandia to study relativistic electron beam propagation in the ion-focused regime. The present version of the code evaluates the force on a particle by summing over all the other particles, thus the execution time is proportional to N^2 where N is the number of simulation particles. A new gridless field solver has been developed with time scaling of N log N and the breakeven point between the old and new code is around N = 64 on the Cray X-MP computer. For N = 1000, the new solver is about nine times faster than the old version. The new solver is based on a solution of the two-dimensional Poisson equation which if Fourier decomposed in the azimuthal direction and the solution of the radial equation is represented by integrals over the charge density. These integrals are then replaced by sums over the simulation particles which are assumed to be point particles. The near-field singularity is removed by the Fourier decomposition so long as the number of Fourier modes is much less than the number of simulation particles. The algorithm is written in such a way that the field due to a given species is Fourier decomposed with respect to the center of mass of that species, thus it is possible to study linear and nonlinear ion hose physics with a very small number of azimuthal modes. Typically M = 2 is found to be sufficient for most IFR problems. The old and new solvers have been compared and the agreement is excellent. 2 refs., 3 figs.

52998 (SLAC-PUB–5056) **Commissioning experience with the SLC Arcs.** Barklow, T.L.; Chao, Yu-Chiu; Hutton, A.; Toge, N.; Walker, N.J. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Aug 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-890803–23: International conference on high energy accelerators, Tsukuba (Japan), 20-26 Aug 1989). Order Number DE90000945. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The SLC Arc transport line brings high energy, high intensity electron and positron bunches from the SLAC linac to the Stanford Linear Collider final focus section. In this paper we will review the latest techniques developed to diagnose and correct the optical properties of the SLC Arcs. These techniques could be relevant to the design of long beam transport lines in future particle colliders. 6 refs., 2 figs.

52999 (SLAC-PUB–5091) **Beam dynamics in linear colliders.** Ruth, R.D. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Sep 1989. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-890803–20: International conference on high energy accelerators, Tsukuba (Japan), 20-26 Aug 1989). Order Number DE90000937. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

In this paper, we discuss some basic beam dynamics issues related to obtaining and preserving the luminosity of a next generation linear collider. 17 refs., 1 fig.

53000 Calculations and measurements for the SLAC SLC positron return quadrupole magnet. Early, R.A. (Stanford Linear Center, Stanford, CA (US)); Cobb, J.K. pp. 2030 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S IEEE Service Center, Piscataway, NJ (1987). (CONF-870302–: Particle accelerator conference, Washington, DC (USA), 16-19 Mar 1987).

The three-dimensional magnetostatic computer program TOSCA, running on the NMFECC CRAY X-MP computer, was used to compute the integral of gradient length for the SLC type QT4 positron return line quadrupole magnet. Since the bore diameter of the magnet is 12.7 centimeters, and the length is only 10.16 centimeters, three dimensional effects are important. POISSON calculations were done on a two-dimensional model to obtain magnetic shimming which assured enough positive twelve pole to offset end effects, while TOSCA was used to estimate the effective length of the quadrupole. No corrections were required on the magnet as built. Measurements showed that the required integrated gradient was achieved for the given current, and that integrated higher harmonics were generally less than 0.1 percent of the quadrupole component.

53001 Perturbation method for the measurement of longitudinal and transverse beam impedance. Barry, W. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)); Lambertson, G.R. pp. 1602-1604 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S IEEE Service Center, Piscataway, NJ (1987). (CONF-870302–: Particle accelerator conference, Washington, DC (USA), 16-19 Mar 1987).

A perturbation method utilizing metallic and dielectric spheres to measure longitudinal and transverse beam and pickup impedances in accelerator components is described. The method was used to measure the longitudinal and transverse beam impedances of the 1-2 GeV light source beam pipe. In addition, the technique was used to measure the transverse pickup impedance of a 2 GHz cavity type Schottky signal monitor currently being installed in the FNAL Tevatron. Measurement results for both cases are presented.

4303 Auxiliaries and Components

Refer also to citation(s) 52915, 53001, 53060, 53085, 53111

53002 (BNL–43249) **Magnetic field of a toroidal volume H^{minus} source.** Meitzler, C.R. Brookhaven National Lab., Upton, NY (USA). 5 Sep 1989. 19p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. Order Number DE90001270. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A volume H^- source has been constructed by Prelec at BNL. The magnetic field for this source has been calculated using the computer code PANDIRA. A comparison of the magnetic fields for two cases is presented. 5 refs., 6 figs., 1 tab.

53003 (BNL–43269) **Smith-Purcell radiation from commercial gratings.** Wang, Xijie. Brookhaven National Lab., Upton, NY (USA). 7 Sep 1989. 20p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. Order Number DE90001530. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The recent optimization of the computer program PERCY is summarized in this report. It is then used to study the Smith-Purcell radiation from Edmund gratings. 5 refs., 14 figs.

53004 (BNL–43285) **Design features of the SSC [Superconducting Super Collider] dipole magnet.** Willen, E.; Cottingham, J.; Ganetis, G.; Garber, M.; Ghosh, A.; Goodzeit, C.; Greene, A.; Herrera, J.; Kahn, S.; Kelly, E. Brookhaven National Lab., Upton, NY (USA). [1989]. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890803–27: International conference on high energy accelerators, Tsukuba (Japan), 20-26 Aug 1989). Order Number DE90001329. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The main ring dipole for the SSC is specified as a high performance magnet that is required to provide a uniform, 6.6 T field in a 4 cm aperture at minimum cost. These design requirements have been addressed in an R&D program in which the coil design, coil mechanical support, yoke and shell structure, trim coil and beam tube design, and a variety of new instrumentation, have been developed. The design of the magnet resulting from this intensive R&D program, including various measurements from both 1.8 m and 17 m long models, is reviewed. 7 refs., 3 figs.

53005 (BNL–43318) **Stepping motor adaptor actuator for a commercial uhv linear motion feedthrough.** Iarocci, M.; Oversluizen, T. Brookhaven National Lab., Upton, NY (USA). [1989]. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890802–7: 7. synchrotron radiation instrumentation (SRI) national conference, Berkeley, CA (USA), 6-10 Aug 1989). Order Number DE90001550. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

An adaptor coupling has been developed that will allow the attachment of a standard stepping motor to a precision commercial (Varian) uhv linear motion feedthrough. The assembly, consisting of the motor, motor adaptor, limit switches, etc. is clamped to the feedthrough body which can be done under vacuum conditions if necessary. With a 500 step/rev. stepping motor the resolution is 1.27 μm per step. We presently use this assembly in a remote location for the precise positioning of a beam sensing monitor. 2 refs., 3 figs.

53006 (BNL–43336) **The scanning transmission microscope at the NSLS [National Synchrotron Light Source].** Rarback, H.; Buckley, C.; Goncz, K.; Ade, H.; Anderson, E.; Attwood, D.; Batson, P.; Hellman, S.; Jacobsen, C.; Kern, D.; Kirz, J.; Lindaas, S.; McNulty,I.; Oversluizen, M.; Rivers, M.; Rothman, S.; Shu, D.; Tang, Eshang. Brookhaven National Lab., Upton, NY (USA). 1989. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890802–5: 7. synchrotron radiation instrumentation (SRI) national conference, Berkeley, CA (USA), 6-10 Aug 1989). Order Number DE90001555. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The scanning transmission soft x-ray microscope (STXM), that has been under development at the National Synchrotron Light Source has been substantially upgraded for operation with the X1 undulator. The principal new features are: optical prefocusing, using a visible light interferometer, a dedicated VAXstation 3200 with a more user friendly and flexible software system for image acquisition and analysis, a flow cell that makes it possible not only to keep the specimen wet during exposure, but to change the fluid around the specimen as well, and a more compact proportional counter that is capable of counting rates of several MHz. In conjunction with new zone plates of better resolution and higher efficiency, the microscope is ready for a period of extended use in biological imaging. 9 refs., 6 figs.

53007 (BNL–43371) **The superconducting wiggler at the NSLS [National Synchrotron Light Source]: Systems description and initial experience.** Decker, G. Brookhaven National Lab., Upton, NY (USA). [1989]. 24p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890802–2: 7. synchrotron radiation instrumentation (SRI) national conference, Berkeley, CA (USA), 6-10 Aug 1989). Order Number DE90001558. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The superconducting wiggler at the National Synchrotron Light Source and its associated systems are described. The operation and performance of the wiggler, in addition to its effects on X-ray ring operation, are discussed. Experimental results are presented. 10 refs., 5 figs., 2 tabs.

53008 (CERN/LEP-MA–88-54) **Search coil measurements of particle accelerator magnets.** Henrichsen, K.N. European Organization for Nuclear Research, Geneva (Switzerland). Oct 1988. 6p. (CONF-8810196–3: Magnet design workshop, Vancouver (Canada), 3-5 Oct 1988). Order Number DE90000114. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI.

Specific problems related to search coil measurements in magnets for particle accelerators are discussed. This includes the coil manufacture and calibration as well as the measurement of the magnetic flux. 12 refs., 3 figs.

53009 (CONF-890803–28) **Recent developments of gigatron technology.** McIntyre, P.M.; Elliott, S.M.; Gray, H.; Lee, B.; Pang, Yaoqi; Popovic, M. Texas A and M Univ., College Station, TX (USA). Dept. of Physics; Naval Research Lab., Washington, DC (USA). [1989]. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-85ER40236. From International conference on high energy accelerators; Tsukuba (Japan); 20-26 Aug 1989. Order Number DE90001067. Available from NTIS, PC A02/MF A01; OSTI; INIS.

Gigatron is a new design concept for microwave power devices. A gated field-emitter array is employed as a directly modulated cathode. A ribbon beam configuration is used to mitigate space-charge effects and provide for efficient output coupling. A traveling-wave output coupler is used to obtain optimum coupling to a wide beam. Recent cathode tests are reported. Modeling of the bunched-emission process has led to an improved cathode fabrication procedure. A new application of a similar structure has led to a design for a new technology for precision tracking chambers for SSC detectors.

53010 (CONF-8806243–45) **A microwave power driver for linac colliders: Gigatron.** Bizek, H.M.; Elliott, S.M.; McIntyre, P.M.; Nassiri, A.; Popovic, M.B.; Raparia, D.; Gray, H.F. Texas A and M Univ., College Station, TX (USA). Dept. of Physics. 18 Nov 1988. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-85ER40236. From DPF summer study: Snowmass '88: high energy physics in the 1990s; Snowmass, CO (USA); 27 Jun - 15 jul 1988. Order Number DE90001064. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The gigatron is a new rf amplifier tube designed for linac collider applications. Three design features permit extension of the lasertron concept to very high frequencies. First, a gated field-emitter array is employed for the modulated cathode. Second, a ribbon beam geometry mitigates space charge depression and facilitates efficient output coupling. Third, a traveling wave output coupler is used to obtain optimum coupling to the ribbon beam. This paper describes recent developments in the gigatron design, and progress towards experimental tests. 9 refs., 8 figs., 1 tab.

53011 (CRN-VIV–52) **Transmission measure. Extrapolation to the Vivitron.** Rebmeister, R. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. May 1988. 22p. (In French). Order Number DE90713795. Available from NTIS (US Sales Only), PC A03/MF A01.

Transmission measurements have been done for the accelerator Vivitron. The results are positive (T=0.97) Maximum energy and maximum transmission are incompatible. If maximum energy is needed, a foil stripper is required, otherwise a gas stripper gives better transmission.

53012 (CRN-VIV–53) **Installation of a generator. Status as of May 15 1988.** Heugel, J. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. May 1988. 7p. (In French). Order Number DE90713796. Available from NTIS (US Sales Only), PC A02/MF A01.

The status of the generator installation for the project Vivitron as of May 1988 is shown. The list of ordered materials and the balance-sheet of the done work are given. Work to be done is indicated.

53013 (CRN-VIV–61) **Installation of a generator. Status as of January 27, 1989.** Heugel, J. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1989. 8p. (In French). Order Number DE90713793. Available from NTIS (US Sales Only), PC A02/MF A01.

The document is a status of the generator installation for the project Vivitron as of January 1989. It gives the list of ordered materials and a balance-Sheet of the work done. It gives the outline of the next work to be done.

53014 (CTA-IEAv-RP–09/85) **Studies of vaccum systems for a linear electron acelerator.** Goncalez, O.L.; Silva, R. Centro Tecnico Aeroespacial, Sao Jose dos Campos, SP (Brazil). Inst. de Estudos Avancados. 1985. 10p. (In Portuguese). Order Number DE90606766. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

In the study of vaccum parameter system in the structure of a linear electron accelerator feeded by radio-frequency, the periodical release of adsorbed gases should be considered. For high power machines a structure inside a vaccum shield are recommended. (author).

53015 (DOE/ER/40150–90) **Superconducting rf for direct acceleration in TeV colliders.** Sundelin, R.M. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84ER40150. (CEBAF-PR–88-021;CONF-8910219–3: Linac conference, Williamsburg, VA (USA), 3 Oct 1989). Order Number DE90000769. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The extensive effort by many of the world's best accelerator personnel which has been required for the commissioning of the SLC shows that pushing the SLC design parameters further will be extraordinarily difficult, if not impossible. Use of parameters which are equal to or less restrictive than those of the SLC, together with large-scale application of superconducting cavity gradients which have been achieved on a small scale, makes a 2 TeV e^+e^- collider worthy of consideration. The low peak power required to fill a high Q cavity and a high ratio of higher order mode damping rate to fundamental power dissipation make a linac using superconducting RF accelerating cavities and periodic bunch trains a potentially viable solution. 4 refs.

53016 (DOE/ER/40150–91) **CEBAF [Continuous Electron Beam Accelerator Facility] linac cryogenic instrumentation requirements and a review of the available sensors.** Rao, M.G. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. 1989. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84ER40150. (CEBAF-PR–88-022;CONF-8910219–1: Linac conference, Williamsburg, VA (USA), 3 Oct 1989). Order Number DE90000771. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

CEBAF's Linac and the associated cryogenic refrigeration system need to be carefully instrumented for their successful installation and operation. The important cryogenic instrumentation requirements include temperature, pressure, liquid level and flow. In this paper a critical review of the available sensors will be presented. Further, the wide operating temperature range, interchangeability and high radiation hardness requirements of the sensors will also be discussed. 3 refs., 4 figs., 1 tab.

53017 (DOE/ER/40150–95) **High repetition rate kickers for linear colliders.** Heifets, S.; Rossmanith, R. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84ER40150. (CEBAF-PR–89-020;CONF-881049–76: 14. linear accelerator conference (LINAC-14), Williamsburg, VA (USA), 3-7 Oct 1988). Order Number DE90000763. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

It was shown in a previous paper that kickers with a high repetition rate can be designed by combining several cavities operating in a deflecting mode. In this paper we simplify this idea by showing that such kickers can be built also with one cavity or with an assembly of coupled cavities operating at several frequencies. We also demonstrate that this concept can be used for accelerating cavities. The electrical breakdown limit for such multimode accelerating cavities will be significantly higher than conventional single-mode cavities; therefore higher acceleration gradients, e.g., for linear colliders, can be achieved. 2 refs., 4 figs.

53018 (DOE/ER/40150–96) **Design of CEBAF's [Continuous Electron Beam Accelerator Facility] rf separator and results of cold tests.** Yao, C.G. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. [1989]. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84ER40150. (CEBAF-PR–89-021;CONF-8910219–2: Linac conference, Williamsburg, VA (USA), 3 Oct 1989). Order Number DE90000770. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The design of the CEBAF accelerator system is based upon a multipass racetrack configuration, the straight sections of which will utilize 1497-MHz superconducting linac sections with independent magnetic transport at the end of each linac segment. Room temperature SW rf separators operating at a frequency of 998 MHz will be used in each independent transport channel at one end of the racetrack to extract a portion of the recirculating current. With the frequency chosen and appropriate phasing, three independent beams of correlated energy may be extracted for use in the three experimental areas. The design of the rf separators, abased on an alternating periodic structure (APS), will be described and some preliminary prototype cold test results will be given. 11 refs., 10 figs., 2 tabs.

53019 (DOE/ER/40150–99) **Use of the TACL [Thaumaturgic Automated Control Logic] system at CEBAF [Continuous Electron Beam Accelerator Facility] for control of the Cryogenic Test Facility.** Navarro, E.; Keesee, M.; Bork, R.; Grubb, C.; Lahti, G.; Sage, J. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84ER40150. (CEBAF-PR–89-024;CONF-890545–17: 6. conference on real-time computer applications in nuclear, particle and plasma physics, Williamsburg, VA (USA), 15-19 May 1989). Order Number DE90000760. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

A logic-based control software system, called Thaumaturgic Automated Control Logic (TACL), is under development at the Continuous Electron Beam Accelerator Facility in Newport News, VA. The first version of the software was placed in service in November, 1987 for control of cryogenics during the first superconducting RF cavity tests at CEBAF. In August, 1988 the control system was installed at the Cryogenic Test Facility (CTF) at CEBAF. CTF generated liquid helium in September, 1988 and is now in full operation for the current round of cavity tests. TACL is providing a powerful and flexible controls environment for the operation of CTF. 3 refs.

53020 (DOE/ER/40150–101) **Rf control system development at CEBAF [Continuous Electron Beam Accelerator Facility].** Simrock, S.; Hovater, C.; Jones, S.; Fugitt, J. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84ER40150. (CEBAF-PR–89-026;CONF-890335–258: 13. particle accelerator conference, Chicago, IL (USA), 20-23 Mar 1989). Order Number DE90000758. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The CEBAF RF control system uses a heterodyne scheme to convert the cavity frequency of 1497 MHz down to a more manageable IF frequency of 70 MHz. At this IF frequency all the signal processing is done. Because of the tight system requirements of $\pm 0.2°$ phase stability and $\pm 2 \cdot 10^{-5}$ amplitude stability, CEBAF uses new technologies such as high speed analog circuits at 70 MHz. Major themes include components for signal processing in the control system and recent system performance tests. 6 refs., 6 figs.

53021 (DOE/ER/40150–102) **Status of the CEBAF [Continuous Electron Beam Accelerator Facility] injector.** Diamond, W.T.; Pico, R. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84ER40150. (CEBAF-PR–89-027;CONF-881049–77: 14. linear accelerator conference (LINAC-14), Williamsburg, VA (USA), 3-7 Oct 1988). Order Number DE90000757. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The injector for the CEBAF cw superconducting linac consists of a 100 keV electron gun, two choppers and a buncher. A short, room temperature, graded-β, sidecoupled accelerator is used to increase the electron beam energy to about 500 keV to produce a good match into the first superconducting accelerator cavity. Eighteen five-cell superconducting cavities are used to produce an energy of 45 MeV before injection into the first linac. All of the room temperature centerline hardware has been installed on a strongback. Testing of the 100 keV electron gun and transport system is in progress. The rf system for the choppers and buncher is nearly complete and the first rf tests are in progress. 5 refs., 7 figs., 1 tab.

53022 (DOE/ER/40150–103) **Thermionic gun control system for the CEBAF [Continuous Electron Beam Accelerator Facility] injector.** Pico, R.; Diamond, B.; Fugitt, J.; Bork, R. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84ER40150. (CEBAF-PR–89-028;CONF-881049–78: 14. linear accelerator conference (LINAC-14), Williamsburg, VA (USA), 3-7 Oct 1988). Order Number DE90000756. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The injector for the CEBAF accelerator must produce a high-quality electron beam to meet the overall accelerator specifications. A Hermosa electron gun with a 2 mm-diameter cathode and a control aperture has been chosen as the electron source. This must be controlled over a wide range of operating conditions to meet the beam specifications and to provide flexibility for accelerator commissioning. The gun is controlled using Computer Automated Measurement and Control (CAMAC IEEE-583) technology. The system employs the CAMAC-based control architecture developed at CEBAF. The control system has been tested, and early operating data on the electron gun and the injector beam transport system has been obtained. This system also allows gun parameters to be stored at the operator location, without paralyzing operation. This paper describes the use of this computer system in the control of the CEBAF electron gun. 2 refs., 6 figs., 1 tab.

53023 (FNAL/C–89/162) **Beam extraction from TeV accelerators using channeling in bent crystals.** Carrigan, R.A. Jr.; Toohig, T.E.; Tsyganov, E.N. Fermi National Accelerator Lab., Batavia, IL (USA). Aug 1989. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-890821–5: 13. international conference on atomic collisions in solids, Aarhus (Denmark), 7-11 Aug 1989). Order Number DE90001575. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Bent crystal channeling offers an interesting alternative for beam extraction from trans-GeV accelerators. Conventional extraction employs resonant beam blow-up coupled with electromagnetic beam deflecting channels. It is limited by the length of the available accelerator straight section. Channeling crystals require much less space. A five-step approach to applying crystal extraction in the Superconducting Super Collider (SSC) is discussed. Two steps, extraction from the 8 GeV Dubna Synchrophasotron and the 76 GeV Serpukhov accelerator, have occurred. The next possibility is extraction from a multi-hundred GeV superconducting accelerator. In the nineties the program could continue at UNK (3 TeV) and culminate at the TeV SSC. The possibilities and limitations of crystal extraction are reviewed. More information is needed on dechanneling in bent crystals including the effects of dislocations at TeV energies. Long, "dislocation-free" crystals are required. A more thorough understanding of the theory of crystal extraction is also desirable. 12 refs.

53024 (FNAL-TM–1605) **A novel flattop current regulated energy discharge type pulsed power supply and magnet yielding 4.4 kGauss-meter for 6 milliseconds.** Visser, A.T. Fermi National Accelerator Lab., Batavia, IL (USA). Jul 1989. 39p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. Order Number DE90001878. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Most energy discharge power supplies obtain their bursts of power from the energy stored in charged capacitors when it is suddenly released into a load. This note describes the design of a similar small 800 Joules energy discharge type power supply and magnet. The magnet gap is 2 in. x 2 in. x 25-1/2 in. long and produces about 4.4 kGauss-meters at a rate of 12 pulses per minute. Each pulse is current regulated at the top for a duration of 6 msec. and varies less than 0.6% of set value. Current regulation at flattop is obtained by switching a resistor in and out of the discharge circuit with an IGBT at a rate of about 5 kHz. Most energy discharge systems produce half sine wave pulses, and current regulation is obtained by controlling the charge voltage at the energy storage capacitor, resulting only in a controlled peak current value of the half sine wave pulse. The current value at the top changes substantially during 6 msec. depending on the operating frequency.

53025 (FNAL-TM–1624) **Superconducting dipole magnet requirements for the Fermilab Phase 3 upgrade, SSC high energy**

booster, and Fermilab independent collider. Nicol, T.H.; Kerby, J.S. Fermi National Accelerator Lab., Batavia, IL (USA). Sep 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-890872–1: Workshop on physics at Fermilab in the 1990's, Breckenridge, CO (USA), 15-24 Aug 1989). Order Number DE90001874. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

In July 1988 a small working group was formed to develop a conceptual design for a high field superconducting dipole magnet suitable for use in the Phase III upgrade at Fermilab. The Phase III upgrade calls for replacement of the existing Tevatron with higher field magnets to boost the energy of the fixed target program to 1.5 TeV and to add a 1.8 TeV collider program. As the work of this group evolved it became clear that the resulting design might be applicable to more than just the proposed upgrade. In particular, it seemed plausible that the work might be applicable to the high energy booster (HEB) for the SSC. At the Breckenridge Workshop in August 1989 interest in a third project began to surface, namely the revamping of an earlier proposal for a dedicated collider at Fermilab. We refer to this proposal as the FNAL Independent Collider. The requirements for the dipole magnets for this independent collider appear to be remarkably similar to those proposed for the Phase III upgrade and the SSC HEB. The purpose of this report is to compare the conceptual design of the dipoles developed for the Phase III proposal with the requirements of those for the SSC HEB, the FNAL Independent Collider, and a hybrid design which could serve the needs of both. The Phase III design will be used as the reference point for parameter scaling. 4 figs., 3 tabs.

53026 (INIS-mf–12006, pp. 27-28) **Filter target experiment (FILTEX).** Korsch, W. (Marburg Univ. (Germany, F.R.). Fachbereich 13 - Physik); Luck, W.; Fick, D.; Giroux, J.; Graw, G.; Schiemenz, P.; Haeberli, W.; Pohlenz, D.; Zapfe, K.; Brueckner, W. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

The basic idea of the experiment is to polarize antiprotons circulating in a storage ring by means of an internal polarized hydrogen target and to measure spin dependent observables in the panti p interaction. A dense H vector target for the proton test experiment at the TSR is being constructed. It is based on a storage cell, fed by an intense H vector atomic beam source (ABS). The vacuum system of the ABS has been assembled and first results with a new dissociator have been obtained during the last year. The status of the ABS is described. (orig.).

53027 (INIS-mf–12006, pp. 34-35) **Design and test of an electrostatic deflector for fission isomers.** Backe, H. (Mainz Univ. (Germany, F.R.). Inst. fuer Physik); Bloenningen, T.; Dahlinger, M.; Hies, M.; Klaft, I.; Lauth, W.; Scherrer, A.; Schwamb, P.; Habs, D. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

An electrostatic deflector was built and coupled with our fission isomer accelerator in order to avoid a direct sight between the target and the gas filled optical cell. The features of the deflector were tested with postaccelerated fission isomers (U=90 KV) from ^{242}Pu(d,2n)^{242m}Am reactions. (orig.).

53028 (INIS-mf–12006, pp. 35) **Improvement of the proton microprobe.** Bajt, S.; Kacar, B.; Povh, B.; Scherer, J.; Traxel, K. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

A new secondary electron imaging system can now be routinely used for data acquisition. All functions are controlled by a personal computer leading to strong improvements in stability of the deflected beam, scanning speed, and comfort in beam positioning and focusing. (orig.).

53029 (INIS-mf–12006, pp. 38-43) **Nuclear solid state physics and technology.** Bhatia, K.L. (Rohtak Univ. (India)); Boehringer, K.; Boerret, R.; Derst, G.; Ginsbach, B.; Guenzler, R.; Hirschel, W.; Izsak, K.; Joest, P.; Jousten, K. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Nuclear instruments and methods have been applied to solid state physics and technology problems. (orig.).

53030 (INIS-mf–12006, pp. 46) **General target preparation.** Baumann, H. (Frankfurt Univ. (Germany, F.R.). Inst. fuer Kernphysik); Hinderer, S.; Kayser, J.; Sapir, L.; Schuehrer, B.; Wirth, H.L. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

About 570 targets from 28 different isotopes have been prepared in addition to 600 stripper foils for the accelerators. (orig.).

53031 (INIS-mf–12006, pp. 89-96) **Laser diagnostics and cooling of ^{7}Li^{+} and ^{9}Be^{+}.** Baumann, W. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.)); Faulstich, A.; Habs, D.; Jaeschke, E.; Kraemer, D.; Petrich, W.; Welti, K.; Zwickler, S.; Berger, J.; Blatt, P. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

In a first test experiment a strong fluorescence signal of the $2^3S_1(F=5/2) - 2^3P_2(F=7/2)$ transition in metastable Li^+ ions has been observed when irradiating a 3 μA beam at 9.12 MeV with 20 mW/cm^2 laser light of 17290.06 cm^{-1}. Rather accurate laser diagnostic investigations of the stored ion beam have been performed; an absolute beam energy of 9.12246(1) MeV and a longitudinal momentum spread $\Delta p/p=0.5\times10^{-4}$ was determined. At an average pressure of 7×10^{-10} mbar in the TSR the lifetime of the metastable Li^+ ions was limited to 650 ms; the energy loss of the metastable Li^+ was determined to be 19 eV in 100 ms. A laser cooling effect, however, was not yet observed. In preparation for a laser cooling experiment on $^{9}Be^{+}$ a light intensity of 15 mW was produced at 300 nm by frequency doubling with an ADA crystal in the cavity of a ring dye laser. Vacuum testing of a special laser cooling section with retarding potentials and mirrors has been started. (orig.).

53032 (INIS-mf–12006, pp. 97-100) **The ultra-cold electron beam.** Baumann, W. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.)); Faulstich, A.; Habs, D.; Jaeschke, E.; Kraemer, D.; Petrich, W.; Welti, K.; Zwickler, S.; Berger, J.; Blatt, P. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

The production of high currents by laser induced emission from a GaAs photocathode was investigated in a test setup. The quantum efficiency depended on many details of the preparation of the cathode. For periods of a few seconds electron currents up to 1.3 mA have been obtained. The important quantitiy controlling the lifetime of the photocathode seems to be the laser light intensity. For currents up to 50 μA lifetimes of many hours have been observed. However, at present the lifetime for a 1 mA current produced by irradiating with 160 mW of laser light was 16 sec. Since an order of magnitude improvement in the quantum efficiency seems possible, much longer lifetimes should be obtainable in future tests. In computer simulations of the electron gun design was found a significant reduction of the final transversal beam temperature, by modifying the standard constant magnetic field and the cosine shape of the accelerating potentials along the electron path. (orig.).

53033 (LAPP-EXP–89-01) **ECLine - Driver: a flexible, 20MHz, 256 words ECLine generator.** Chollet, F.; Degre, A.; Lacotte, J.C.; Lecoq, J. Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules. Jan 1989. 7p. Order Number DE90713765. Available from NTIS (US Sales Only), PC A02/MF A01.

The ECLine - Driver is a dual 256x16 - bits words fast ECLine generator fully controlled by CAMAC. Designed to fit requirements of High Energy Physics experiments, its flexibility makes it a general purpose unit. It is used on the LEP - L3 experiment, at CERN, to implement two applications. In the first one, it generates the "trigger

detector" response in order to exercize the different trigger processors under experimental conditions. In the second one, it generates some 10000 synchronisation signals required to drive the level-1 energy trigger processor. 70 units are installed on the experiment.

53034 (LBL–26619) **Short sample testing facility for the Superconducting Super Collider: Requirements and development status.** Zbasnik, J.; Scanlan, R.; Taylor, C.; Peters, C.; Pope, W.; Royet, J. Lawrence Berkeley Lab., CA (USA). Jun 1989. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. SSC-MAG-245. (CONF-890701–10: International cryogenic materials conference, Los Angeles, CA (USA), 24-28 Jul 1989). Order Number DE90001423. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In this paper we present the system requirements of the apparatus measuring the short sample critical current of the cable for the Superconducting Super Collider (SSC), and the current status of our development work. Key features of the system presented here are: a sample holder which clamps the samples sufficiently well such that no training quenches are required to perform critical current measurements and another which may allow for faster sample mounting; voltage tap boards using a printed-circuit technique which eliminates the necessity of soldering wires for the voltage measurements; a 1-m ling, 5-cm-bore dipole magnet with close-in iron designed to produce 7.5 T with a 6000 A excitation current; and an air-lock system that allows repeated sample changes without the magnet chamber being contaminated with air and other impurities. 7 refs., 6 figs.

53035 (SAND–89-2127C) **RLA [Recirculating Linear Accelerator] vertical turning field design.** Freeman, J.R. Sandia National Labs., Albuquerque, NM (USA). 1989. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC04-76DP00789. (CONF-8909216–3: DARPA/SDIO service annual charged particle beam review, Monterey, CA (USA), 18-21 Sep 1989). Order Number DE90001386. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The Recirculating Linear Accelerator (RLA) uses ion-focusing to provide the radial confinement of the beam. At the ends of the ion-channel racetrack, a ramped vertical magnetic field will be required to keep the beam in the channel. A sector field, whose strength increases with distance from the channel axis, has been proposed to provide an energy bandwidth for the transport system. This manuscript reports on design studies for coil systems that produce the required fields. It also describes particle simulations in the combined IFR-B-field transport system to address the issues of energy bandwidth and emittance growth. 4 refs., 6 figs.

53036 (SAND–89-2181C) **Recirculating linear accelerator (RLA) injector and accelerating cavity improvements.** Smith, D.L.; Mazarakis, M.G.; Bennett, L.F.; Haworth, M.D.; Lucero, S.J. Sandia National Labs., Albuquerque, NM (USA). [1989]. 5p. Sponsored by U.S. Department of Defense; U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8909216–5: DARPA/SDIO service annual charged particle beam review, Monterey, CA (USA), 18-21 Sep 1989). Order Number DE90000805. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Concerns about low-γ relativistic electron beams (REB) being initially injected into the RLA and about energy spreads due to degradation of the accelerating cavity repeating pulse shapes have resulted in our designing a new 4-MV, 20-kA injector, improving the 24-switch trigger system for the ET-2 cavity, and identifying critical factors in the cavity design that affect the pulse shape. We summarize the Metglas inductively isolated, stacked cavity injector design and report on the improvements (completed and proposed) for the ET-2 cavity pulsed power. 7 refs., 6 figs.

53037 (SD-TR–89-64) **Thermionic emission including both space charge and image forces.** Lin, T.P.; Eng, G. Aerospace Corp., El Segundo, CA (USA). Chemistry and Physics Lab. 1 Sep 1989. 29p. Sponsored by U.S. Department of Defense. F04701-85-C-0086-P00016. Order Number DE90000069. Available from NTIS, PC A03/MF A01 - OSTI.

The net emission current for a uniform planar thermionic emitter is determined for a range of voltages, temperatures, and various values of the work function. Poisson's equation is self-consistently solved, using numerical techniques, without any additional phenomenological assumptions. This work accurately specifies the net current in the transition region between space-charge-limited and temperature-limited emission, and we present the first determination of the shape of the interelectrode potential there. A comparison with earlier approximate techniques is also included. 15 refs., 10 figs.

53038 (SLAC-PUB–5070) **Recent progress in relativistic klystron research.** Allen, M.A.; Callin, R.S.; Deruyter, H.; Eppley, K.R.; Fant, K.S.; Fowkes, W.R.; Hoag, H.A.; Koontz, R.F.; Lavine, T.L.; Loew, G.A.; Miller, R.H.; Ruth, R.D.; Vlieks, A.E.; Wang, J.W.; Aalberts, D.P.; Boyd, J.K.; Houck, T.; Ryne, R.D.; Westenskow, G.A.; YuStanford Linear Accelerator Center, Menlo Park, CA (USA). Aug 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515;W-7405-ENG-48;AC03-76SF00098. (CONF-890803–22: International conference on high energy accelerators, Tsukuba (Japan), 20-26 Aug 1989; LBL–27760; UCRL–101688). Order Number DE90000942. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Experimental work is now under way by collaborators at LLNL, SLAC, and LBL to investigate relativistic klystrons as a possible rf power source for future high-gradient accelerators. We have learned how to overcome our previously reported problem of high-power rf pulse shortening and have achieved peak rf power levels of 290 MW. We have used the rf from a relativistic klystron to power a short, 11.4-GHz high-gradient accelerator. The measured momentum spectrum of the accelerated electron beam corresponds to an accelerating gradient of 84 MV/m. 5 refs., 7 figs.

53039 (UCRL–101193) **17.1 GHz free-electron laser as a microwave source for TeV colliders.** Jong, R.A.; Ryne, R.D.; Westenskow, G.A.; Yu, S.S.; Hopkins, D.B.; Sessler, A.M. Lawrence Livermore National Lab., CA (USA). 11 Sep 1989. 26p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48;AC03-76SF00098. (CONF-8908134–7: 11. international free electron laser conference, Naples, FL (USA), 28 Aug - 1 sep 1989). Order Number DE90001506. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We describe the proposed development of a 17.1-GHz microwave source based on an induction-linac driven free-electron laser that is expected to produce peak power levels at the several gigawatt level. This system is being designed to serve as the power source for a tera-electron-volt (TeV) linear collider or for other high gradient accelerators. We will discuss the power source requirements for TeV colliders and present the initial design of an FEL that will produce the desired power. In addition, we shall discuss efficiency enhancement schemes such as a relativistic klystron "afterburner," the requirements for beam reacceleration, and concepts for extraction of the microwave power while preserving key properties of the beam such as emittance and phase. 19 refs., 11 figs.

53040 **Laser driven photocathode studies for high gradient accelerators.** Srinivasan-Rao, T. (Brookhaven National Lab., Upton, NY (USA)); Fischer, J.; Tsang, T. pp. 443 of OSA conference on lasers and electro-optics (1989 Technical Digest series). Optical Society of America, Washington, DC (1989). (CONF-890423–: CLEO '89: conference on lasers and electro optics, Baltimore, MD (USA), 24-28 Apr 1989).

Technical Paper JK5.

Novel accelerator concepts such as the switched power linac call for devices which can deliver current densities exceeding 10^5 A/cm^2 from an area of ~1 cm^2 for a few picoseconds. Metal photocathodes driven by short intense laser pulses are ideal for these applications due to their inherently short response time and large electron density. Here, the authors present the experimental results obtained with the metal photocathodes, gold, yttrium, samarium, tantalum, and magnesium, illuminated by 4.66-eV photons of 10-ps pulse duration and 10-Hz repetition rate. The schematic of the experimental arrangement is shown.

53041 **Resonant power supplies for a large synchrotron.** Karady, G. (Los Alamos Nat. Lab., Los Alamos, NM (US)); Kansog, J.; Thiessen, H.A.; Schneider, J. pp. 2030 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S IEEE Service Center,

Piscataway, NJ (1987). (CONF-870302–: Particle accelerator conference, Washington, DC (USA), 16-19 Mar 1987).

The resonance power supply has been proposed as an efficient power supply for a future 60 GeV, kaon factory accelerator. This paper presents a detailed transient analysis of the circuit operation. Based on these analyses each component is designed, one line diagram is developed and component requirements are determined. The major components of the system are: the magnet power supply, high voltage by-pass thyristor switch, with 10kA repetitive interruption capability, capacitor banks, capacitor bank thyristor switch, and an energy injection device.

53042 Analysis of transmission line effects in the SSC magnet system. Calvo, O. (Fermi Nat. Lab., Batavia, IL (US)); Tool, G. pp. 2030 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S IEEE Service Center, Piscataway, NJ (1987). (CONF-870302–: Particle accelerator conference, Washington, DC (USA), 16-19 Mar 1987).

The response of the SSC accelerator magnet string to transient excitation from the power supply is considered. Some criteria for the selection of the optimum damping resistors for the SSC magnets are discussed. The transient response of the load to power supply transients, including the effect of the power supply filter is analyzed. A comparative analysis is made of the differences between two possible configurations in the distribution of the magnets (with and without a return bus.).

53043 The Bevatron liquid nitrogen circulation system. Hunt, D. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA); Stover, G. pp. 2030 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S IEEE Service Center, Piscataway, NJ (1987). (CONF-870302–: Particle accelerator conference, Washington, DC (USA), 16-19 Mar 1987).

A nitrogen liquefier and computer controlled valving system have been added to the Bevatron cryoliner vacuum system to cut operating costs by reducing liquid nitrogen consumption. The computer and interface electronic systems, which control the temperatures of twenty-eight liquid nitrogen circuits, have been chosen and designed to operate in the Bevatron's pulsating magnetic field. The nitrogen exhaust is routed back to a liquefier, of about five kilowatt capacity, liquefied, and rerouted through the cooling circuits. A description of the system and operating results are presented.

53044 Combining multipole data. Michelotti, L. (Fermilab, Batavia, IL (US)). pp. 2030 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S IEEE Service Center, Piscataway, NJ (1987). (CONF-870302–: Particle accelerator conference, Washington, DC (USA), 16-19 Mar 1987).

From June through December of 1986 physicists at the Magnet Test Facility (MTF) at Fermilab measured the fields of forty-eight Main Ring dipoles. Twenty-six of these were B1 style magnets, whose physical apertures are rectangles with rounded corners, roughly 1.4 inches tall by 4.5 inches wide. A harmonic probe sampled the magnetic field of these magnets at three locations separated by one inch; the probe's radius was 0.6 inch.

53045 Mechanical design and fabrication of a 425 MHz H^- buncher. Wilson, N.G. (Los Alamos Nat. Lab., Los Alamos, NM (US)); Precechtel, D. pp. 2030 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S IEEE Service Center, Piscataway, NJ (1987). (CONF-870302–: Particle accelerator conference, Washington, DC (USA), 16-19 Mar 1987).

A beam buncher has been designed, fabricated, and installed on the accelerator test stand (ATS) to match the 2-MeV output beam of a 425-MHz H^- radio-frequency quadrupole (RFQ) into a 425 MHz drift-tube linac (DTL). The buncher configuration provides integral-matching permanent-magnet quadrupoles (PMQ) at the exit of the RFQ and one $\beta\lambda$ across the buncher accelerating gap; a third PMQ is the first DTL half-cell magnet. Located between the second and third PMQs is a 50-Ω, capacitively coupled, beam-sensing pickup loop. Cooling channels are provided in each of the brazed OFHC copper wall sections. Vacuum pumping of the buncher is provided by a cryogenic refrigerator vacuum pump through an array of small-diameter holes in the buncher cavity wall. Mechanical features of the buncher, the brazing and electron-beam welding of the solid-copper buncher structure, and the beam pickup loop are described in this paper. The buncher has been tuned, installed, and operated at full power on the ATS.

53046 RFQ1 fabrication and low power RF tuning. McMichael, G.E. (Atomic Energy of Canada Ltd., Research Co., Chalk River Nuclear Labs., Chalk River, Ontario, K0J 1J0 (CA)); Chidley, B.G.; Hutcheon, R.M.; TranNgoc, T. pp. 2030 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S IEEE Service Center, Piscataway, NJ (1987). (CONF-870302–: Particle accelerator conference, Washington, DC (USA), 16-19 Mar 1987).

RFQ1, a 600 keV, 75 mA proton RFQ is the major component of a research program at the Chalk River Nuclear Laboratories (CRNL) to study high current 100% duty factor accelerator systems and develop improved accelerator technology. Features of the 270 MHz RFQ include removable vanes, vane coupling rings, and loop coupling to the rf drive line with the option of two drive loops. The main RFQ tank and vane bodies are fabricated from carbon steel which is copper plated following machining of the OFHC copper vane tips and initial low power rf tuning. Details of the mechanical fabrication and low power tuning are presented and rf characteristics compared with computer code predictions.

4304 Storage Rings

Refer also to citation(s) 51992, 52010, 52012, 52013, 52858, 52878, 52879, 53042

53047 (BNL–42465) **Vacuum chamber eddy current self-correction for the AGS Booster Accelerator.** Danby, G.T.; Jackson, J.W. Brookhaven National Lab., Upton, NY (USA). 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890803–30: International conference on high energy accelerators, Tsukuba (Japan), 20-26 Aug 1989). Order Number DE90001325. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The large sextupole and other multipoles induced by eddy currents in the vacuum chamber (VC) designed for the AGS Booster dipoles have been cancelled by simple coils attached to the VC surface. A two turns per pole back leg winding provides the mmf required to power the correction coil by transformer action, automatically correcting even for the variable Ḃ magnet excitation. Much larger VC positional errors of translation and rotation are acceptable because the coils follow the VC contour: the aberrations and their corrections locally have the same misplaced coordinate system. The self-correction concept could be applied to quadrupoles. However, Booster quadrupole measurements show that induced higher harmonics from VC and other eddy current sources are very small. Thus, with self-correction of the dipole VC eddy current fields, Ḃ effects on the proton rapid cycling Booster optics are reduced to tracking of the fundamental dipole and quadrupole fields. This can be automatically controlled using field monitoring transducers located in a dipole and quadrupole operated in series with the Booster magnets. 2 refs., 4 figs.

53048 (BNL–43275) **Damping the transverse resistive wall instability in the AGS Booster.** Raka, E. Brookhaven National Lab., Upton, NY (USA). 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890803–31: International conference on high energy accelerators, Tsukuba (Japan), 20-26 Aug 1989). Order Number DE90001324. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

A transverse bunch-to-bunch feedback system will be installed on the AGS Booster to suppress coherent coupled bunch oscillations driven by the resistive wall impedance of the vacuum chamber when accelerating high intensity proton beams (circulating currents > 3 amp). It is possible to estimate the expected growth rate of the instability by scaling from the machine parameters and measurements made on the AGS. An upper limit of 1.5×10^3 sec^{-1} at 1.5 GeV kinetic energy with $X = 0$ and 0.5×10^{13} protons/bunch is obtained for the vertical plane. The position signal of each bunch (h =

3), at two locations separated by one quarter of a betatron wavelength, will be integrated, digitized and stored in a memory whose clock is synchronized with the acceleration frequency. This pair of inputs will be used in conjunction with look up tales, which will be related to a given range of the tune Q, to generate the proper correction amplitude. This will then be D/A converted, amplified and applied to 50Ω traveling wave kickers. The overall time delay will be adjusted to equal or revolution periods in order to permit the necessary digital signal processing (T_o = 0.73 μs at γ = 2.6). An analysis of the performance of this and similar systems for within the bunch modes m = 0, 1 and both zero and non-zero head tail phase shift X will be presented. 4 refs., 1 fig.

53049 (BNL–43276) **The AGS Booster main ring power supply system.** Soukas, A.; Hughes, K.; Sandberg, J.; Toldo, F.; Zhang, S.Y. Brookhaven National Lab., Upton, NY (USA). 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890803–32: International conference on high energy accelerators, Tsukuba (Japan), 20-26 Aug 1989). Order Number DE90001267. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The AGS Booster is being designed as a very versatile particle accelerator. Its primary function is to be a high quality injector to the currently operating Alternating Gradient Synchrotron (AGS). The Booster/AGS combination will produce proton intensities greater than 5 x 10^{13}protons per pulse (ppp), and accelerate heavy ions, with mass up to 200, to a maximum energy of 15 GeV per atomic mass unit (GeV/amu). The power supply for the Booster Main Ring (BMRPS) has to accommodate a wide range of cycles and a wide range of operating parameters. The cycles range from storage for several seconds to rapid cycling at 7.5 Hz. The peak output power is 18 MW. This paper will describe the AGS Booster machine powering requirements, the choice of power supply, the a.c. circuit tie-in and its associated problems and some of the details of the design of the BMRPS. 9 refs., 2 figs.

53050 (BNL–43279) **Landau damping due to tune spreads in betatron amplitude and momentum.** Lee, S.Y.; Tran, P.; Weng, W.T. Brookhaven National Lab., Upton, NY (USA). 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890803–33: International conference on high energy accelerators, Tsukuba (Japan), 20-26 Aug 1989). Order Number DE90001263. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Due to the large space charge transverse impedance in a low energy synchrotron, the coherent tune shift causes the Landau damping to be ineffective in damping the transverse coherent motion. We analyze the effect of Landau damping that is caused by the tune spreads of the betatron amplitude (space charge and/or octupole) and momentum. We find that the Landau damping becomes more significant in our two dimensional analysis. 5 refs.

53051 (BNL–43280) **Progress and status of the AGS Booster project.** Weng, W.T. Brookhaven National Lab., Upton, NY (USA). 1989. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890803–34: International conference on high energy accelerators, Tsukuba (Japan), 20-26 Aug 1989). Order Number DE90001262. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

New physics opportunities, such as: rare K-decay, neutrino and heavy ion physics demand that a rapid-cycling high vacuum and high intensity Booster be built for the AGS at Brookhaven National Laboratory. The circumference of the Booster ring is one-quarter that of the AGS. Three modes of operation for various particles are envisioned. For unpolarized protons, four Booster pulses would be injected at a 7.5 Hz repetition rate within a 400 ms flat bottom of the AGS, enabling the present 1.5 x 10^{13} ppp to be increased to 6 x 10^{13} ppp. The protons would be accelerated to 1.5 GeV although the bending capability provided for heavy ions would eventually allow protons to be accelerated to 2.5 GeV. For heavy ions the rep rates is about 1 Hz and only one pulse would be injected into the AGS. For polarized protons 20 or so pulses can be stored in the Booster ring before injecting them into the AGS. Provisions for mixed modes of operation into a super cycle has been provided for future needs. In this paper, the lattice design and magnet characteristics will be briefly reviewed and major design issues will be discussed and design choices explained. Finally, the construction status and schedule will be presented. 9 refs., 3 figs.

53052 (CONF-8908133–4) **Static and dynamic properties of confined, cold ion plasmas: MD [molecular dynamics] simulations.** Schiffer, J.P. Argonne National Lab., IL (USA). 1989. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. From 24. Yamada conference on strongly coupled plasma physics; Tokyo (Japan); 29 Aug - 2 sep 1989. Order Number DE90001409. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Some four years ago it was suggested that in the new generation of heavy ion accelerator storage rings for multiply charged ions, being planned in Europe, one may well attain internal temperatures that would correspond to very cold plasmas. Since that time, the techniques of electron or laser cooling of such beams has evolved and it may well be possible to reach temperatures corresponding to a plasma coupling parameter $\Gamma >> 100$. I was fortunate to have had an opportunity to collaborate during 1986-87 with my former colleague Aneesur Rahman, of Molecular Dynamics fame, and we adapted the MD method to the calculation of the properties of cold confined plasmas. After Rahman's premature death two years ago I have continued the exploration of these systems and would like to summarize the results here. 9 refs., 10 figs.

53053 (CRN-HE–88-06) **Performance of the Lep Time Digitizer (LTD).** Berst, J.D.; Colledani, C.; Loukas, D. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1988. 15p. Order Number DE90713792. Available from NTIS (US Sales Only), PC A03/MF A01.

Performance of the fastbus digitizer to be used for signal digitizing in the DELPHI detectors is described. Two prototypes, a 128 multihit capability device and a 256 capability device were tested. Test results show that the digitizer works properly. A very good stability is achieved in the range of ± 150 mV from the nominal (-2V) supply with the total number of lost hits of the order of 10^{-6} either in veto or non veto mode. The optimum clock frequency strongly depends on the gates used as delay elements. With the gates of the first prototype, the optimum frequencies obtained are 117 MHz for the first prototype, and 112 MHz for the second. Output linearity is excellent.

53054 (DESY-SR–89-02) **Insertion devices for DORIS III.** Pflueger, J.; Guertler, P. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Apr 1989. 31p. Available from Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.).

To improve the possibilities of synchrotron radiation research at HASYLAB in Hamburg, the storage ring DORIS II will be modified into DORIS III. One 65 m long straight section will be replaced by a new 73.6 m long arc which is built in such a way that space for seven insertion devices will be created. The scientific background and requirements on the wigglers and undulators are briefly mentioned. The optimization procedure leading to the parameters for the proposed devices is described. The requirements on vacuum chamber apertures in the insertion devices, especially for the high energy physics colliding beam operation mode at 5.3 GeV, is discussed. (orig.).

53055 (INIS-mf–12006, pp. 7-22) **The Heidelberg heavy ion storage ring.** Bisoffi, G.; Blum, M.; Frauenfeld, M.; Friedrich, A.; Fuchs, H.; Gahn, P.; Geyer, C.; Grieser, M.; Hahn, W.; Hahn, K. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

During the first quarter of 1988 the main parts of the storage ring were assembled and commissioning of the ring started. After the installation of the bump magnets for multiturn injection the first storage test was done on May 27th 1988. Operating at a magnetic rigidity of 0.71 Tm a 73 MeV C^{6+} beam was successfully injected and stored. Due to the vacuum of 10^{-8} mbar in the unbaked vacuum system the beam lifetime was measured to be tau=4.5 s. Since then 9 beam test have been performed to achieve the full performance of the TSR, e.g. optimization of working point, particle stacking by multiturn and rf stacking giving up to 1.1x10^{10} stored

ions, chromatic correction of large momentum spread beams, measurements of various machine parameters, storing O^{8+}, O^{7+}, O^{6+}, O^{5+}, O^{3+}, C^{6+}, C^{5+}, C^{4+}, C^{3+} and Li^{+} beams at different magnetic rigidities. The activities culminated with the installation of the electron cooler in November when during a beam test on November 17th a cooled C^{6+} beam was circulating in the machine; the initial momentum spread of 2% (rf stacked beam) being cooled down to $2x10^{-4}$ in 2 s. Thus time had come to start with first atomic physics experients in December 1988. (orig.).

53056 (INIS-mf–12006, pp. 83-89) **Charge changing processes of the stored ion beam.** Baumann, W. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.)); Faulstich, A.; Habs, D.; Jaeschke, E.; Kraemer, D.; Petrich, W.; Welti, K.; Zwickler, S.; Berger, J.; Blatt, P. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Experiments aiming at the investigation of recombination of highly charged ions with free electrons have started with the first electron cooling of a C^{6+} beam at TSR. Ions having undergone charge-changing collisions were detected behind the first bending magnet downstream of the cooler using a channeltron detector mounted on a UHV manipulator. Spatial distributions and rates were measured with and without a cooling electron beam. Owing to the relatively high residual gas pressure in the unbaked TSR ($\simeq 5x10^{-10}$ mbar) and to the low beam energy (73 MeV) the electron capture rate in the residual gas was about 5 times higher than the estimated recombination rate with free electrons. In connection with beam lifetime measurements the measured rate confirms that residual gas electron capture was the dominant loss process in TSR with electron cooling. The transverse emittances of the stored beam were derived from the spatial distribution of the detected ions. Spatially resolving solid-state and microchannel plate detectors as well as BaF_2 scintillators have been studied under the aspects of their use in ultrahigh-vacuum and their performance with a relatively high ion intensity. They are in preparation for the next experiments. Furthermore, an optical beam line has been installed for injecting high-power laser pulses into the electron cooling region to study laser-induced recombination. Effects of the resonant scattering of free electrons were considered in view of dielectronic recombination experiments. (orig.).

53057 (LBL–27665) **Beam-beam interaction in an asymmetric collider for B-physics.** Chin, Yong Ho. Lawrence Berkeley Lab., CA (USA). Aug 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890803–26: International conference on high energy accelerators, Tsukuba (Japan), 20-26 Aug 1989). Order Number DE90001216. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

This note is devoted to deriving the minimum criteria to achieve a symmetrical behavior of unequal energy beams in asymmetric colliders for B-physics. The computer simulation results suggest that at least the following quantities should be equalized in the two rings: beam-beam tune shift, cross-sectional area at the interaction point, damping decrement per turn, and betatron phase modulation due to synchrotron motion. 5 refs., 5 figs., 1 tab.

53058 (LBL–27670) **Physics and design issues of asymmetric storage ring colliders as B-factories.** Chattopadhyay, S. Lawrence Berkeley Lab., CA (USA). Aug 1989. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890803–25: International conference on high energy accelerators, Tsukuba (Japan), 20-26 Aug 1989). Order Number DE90001215. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This paper concentrates on generic R&D and design issues of asymmetric colliders via a specific example, namely a 9 GeV x 3 GeV collider based on PEP at SLAC. An asymmetric e^{+}-e^{-} collider at the Y(4s) and with sufficiently high luminosity (10^{33}-10^{34} cm^{-2} s^{-1}) offers the possibility of studying mixing, rare decays, and CP violation in the $B\bar{B}$ meson system, as well as "beautiful" tau-charm physics, and has certain qualitative advantages from detection and machine design points of view. These include: the energy constraint; clean environment (~25% $B^{+}B^{-}$, $B^{0}\bar{B}^{0}$); large cross section (1 nb); vertex reconstruction (from the time development of space-time separated B and $\bar{B}$ decays due to moving center-of-mass); reduced backgrounds; greatest sensitivity to CP violation in $B \rightarrow$ CP eigenstate; the possibility of using higher collision frequencies, up to 100 MHz, in a head-on colliding mode using magnetic separation. It is estimated that for $B \rightarrow \Psi K_s$, an asymmetric collider has an advantage equivalent to a factor of five in luminosity relative to a symmetric one. There are, however, questions with regard to the physics of the asymmetric beam-beam coulomb interaction that may limit the intrinsic luminosity and the possibility of realizing the small beam pipes necessary to determine the vertices. 16 refs., 2 figs.

53059 (ORNL/FTR–3394) **[Advanced accelerator physics featuring the problems of small rings]: Foreign trip report, September 16, 1989–September 29, 1989.** Olsen, D.K. Oak Ridge National Lab., TN (USA). 16 Oct 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90001593. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler attended the CERN Accelerator School and Uppsala University short course on Advanced Accelerator Physics held on the University campus, Uppsala, Sweden, from September 18-29, 1989. The course, attended by 81 people, was well conceived, well presented, and informative. The course was organized and specialized on the problems of small rings. The traveler also visited the CELSIUS ring facility of Uppsala University and the CRYRING ring facility of the Manne Siegbahn Institute in Stockholm, Sweden.

53060 Vacuum system for the synchrotron x-ray source at Argonne. Wehrle, R. (Argonne Nat. Lab., Argonne, IL (US)); Moenich, J.; Kim, S.; Nielsen, R. pp. 2030 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S IEEE Service Center, Piscataway, NJ (1987). (CONF-870302–: Particle accelerator conference, Washington, DC (USA), 16-19 Mar 1987).

The vacuum system of the APS storage ring is designed to maintain a beam-on operating pressure of 1 nTorr or less in order to achieve a positron beam lifetime of approximately 20 hours. The vacuum chamber is an aluminum extrusion containing a beam chamber and antechamber. The primary source of the pumping is with NeG strips. The design and location of the crotches and strip absorbers are based on the distribution of the bending magnet synchrotron radiations.

53061 Fnal booster intensity, extraction, and synchronization control for collider operation. Ducar, R.J. (Fermi Nat. Lab., Batavia, IL (US)); Lackey, J.R.; Tawzer, S.R. pp. 2030 of Proceedings of the 1987 IEEE particle accelerator conference: Accelerator engineering and technology. Lindstrom, E.R.; Taylor, L.S IEEE Service Center, Piscataway, NJ (1987). (CONF-870302–: Particle accelerator conference, Washington, DC (USA), 16-19 Mar 1987).

Booster operation for collider physics is considerably different than for fixed target operation. Various scenarios for collider physics, machine studies, and P-Bar targeting may require that the intensity vary from 5E10 PPP to 3E12 PPP at a 15 Hertz machine cycle rate. In addition to the normal Booster single turn extraction mode, collider operations require that the Booster inject into the Main Ring a small number of beam bunches for coalescing into a single high intensity bunch. These bunches must be synchronized such that the center bunch arrives in the RF bucket which corresponds to the zero phase of the coalescing cavity. The system implemented has the ability to deliver a precise fraction of the availability 84 Booster beam bunches to Main Ring or to the P-Bar Debuncher via the newly installed AP-4 beam line for tune-up and studies. It is required that all of the various intensity and extraction scenarios be accommodated with minimal operator intervention.

44 INSTRUMENTATION

4401 Radiation Instrumentation

Refer also to citation(s) 51877, 51902, 51906, 51908, 51909, 51910, 51918, 51924, 51955, 51956, 51957, 51960, 51961, 51962, 51964, 51965, 51966, 51975, 51991, 52003, 52005, 52015, 52016,

52017, 52018, 53016, 53031, 53056, 53234, 53235, 53236, 53315, 53675, 53751, 53816, 53883, 53982

53062 (BONN-IR–89-01) **On the determination of track parameters with the forward drift chambers of the ZEUS detector.** Guenzel, T.F. Bonn Univ. (Germany, F.R.). Physikalisches Inst. Jan 1989. 123p. (In German). Available from Bonn Univ. (Germany, F.R.). Physikalisches Inst.

The ep-collider HERA at DESY in Hamburg will probe unexplored kinematical regions of the deep-inelastic electron-proton-scattering. The ZEUS-Collaboration develops a detector to study the physical interactions of the incoming particles. Among the requirements of the ZEUS-detector a good momentum resolution of the particle tracks in the inner detector resp. forward tracking detector (FTD) is necessary. The behaviour of the tracks in the forward tracking detector is determined by the lorentzboost (β=0.93) in forward direction and by the inhomogeneous magnetic field in the FTD, which is mainly parallel to the beampipe-axis. In this thesis all studies regard only the FTD (not including VXD or CTD) for the momentum determination. Two scenarios are considered to determine the limits of momentum measurability in the FTD. The results show that the determination of the momentum in the FTD is only possible with the (exact) knowledge of the vertex position, where the tracks come from. The functional dependence of the track parameters at the vertex on the track parameters at the first FTD-module was intensively studied. Disconnected ambiguities are not found. A track model for tracks in the FTD is developed without regarding multiple scattering. The momentum determination of a track is mainly based on the track part between the first FTD-module and the vertex. A momentum resolution of $\sigma p/P$=0.008 P-0.0025 P can be achieved depending on the polar angle (relative to the beampipe-axis) of the track at the vertex. Finally the influence of the multiple scattering between the first FTD-module and the vertex on the momentum resolution is estimated. The increase of the dead material for small polar angles restricts the area of acceptable momentum resolution to polar angles of λ>180 mrad. (orig.).

53063 (CNIC–00196) **Designing means and specifications for model FT-619 kidney function instrument.** Yu Yongding. China Nuclear Information Centre, Beijing, BJ (China). Apr 1988. 7p. (In Chinese). Order Number DE90605571. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

In this paper, it is pointed out that the model FT-619 Kidney Function Equipment is a new cost-effective nuclear medicine instrument, which takes the leading position in China. The performance of the model FT-619,especially the lead collimated scintillation detector has reached the same level as the advanced equipment in the world market. It is also described in this article in detail that the design of the lead collimator and the shielding as well as the detection efficiency have achieved the optimum level and that a comparison has been made with foreign products.

53064 (CRN-PN–88-19) **Neutron radioactivation spectroscopy of residual silver in nuclear emulsions exposed to cosmic radiation. Experiment: EXOBLOC 2 COSMOS 1887.** Heilmann, C.; Seltz, R.; Portal, G.; Gasset, G. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1988. 11p. (In French). Order Number DE90713794. Available from NTIS (US Sales Only), PC A03/MF A01.

Nuclear research emulsions have been used as a spectrometer in an experiment flown aboard a Soviet biosatelite (Cosmos No1887). The percentage of signal of different thresholds (LET between I_0 and 2.21keV/μm, I_0 and18keV/μm and finally between 2.21 and 18keV/μm) has been determined by means of neutron activation of remaining silver in processed emulsions of the three sensitivities. The high activation cross section of ^{109}Ag and the short half-life (24 sec) of ^{110}Ag make the neutron activation method very convenient since they permit short irradiation times and give high counting rates and high detection sensitivity. Results comparable to those obtained by other methods especially SSNTD detectors have been observed.

53065 (IAEA-AL–019, pp. 83-92) **Evaluation of α-spectrometers with surface barrier detectors for low-level measurements.** Matyjek, M. (International Atomic Energy Agency, Seibersdorf (Austria). Laboratories); Cooper, E.L.; LaRosa, J.; Ghods, A. International Atomic Energy Agency, Seibersdorf (Austria). Laboratories. 1989. (CONF-8809405–: Consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna (Austria), 5-9 Sep 1988). In *Report of the consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna, 5-9 September 1988.* Order Number DE90603824. Available from NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS.

Alpha spectrometers are necessary tools for the identification of actinides and the quantitative determination of their radioactivity. The operation characteristics of alpha spectrometry systems have to be known with respect to resolution and counting efficiency. It is advantageous to do this as quickly as possible. This report presents the experience gained with several solid-state detectors and alpha spectrometer units in the Chemistry Unit at the Agency's Laboratories Seibersdorf. 4 figs, 2 tabs.

53066 (INIS-BR–1635) **Characteristics of some track detectors applied for neutron radiography.** Pugliesi, R.; Moraes, M.A.P.V. de; Yamazaki, I.M. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). [1989]. 16p. Order Number DE90606822. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The track etching method has been employed for neutron radiography purposes, by making use of a cold neutron beam obtained at the IEA-R1 Nuclear Research Reactor. The films used were the Solid State Nuclear Track Detectors CN-85, CR-39, MAKROFOL-E and LR-115, with a natural Boron converter screen. In order to obtain mean track diameter about 3 μ with a minimum overlapping between them, adequate conditions for etching and exposure times about 30 minutes and 3 hours respectively were evaluated. For such conditions exposures of 10^9 n/cm^2 that corresponds to 10^7 track/cm^2 are achieved. Neutron radioagraphs of several materials were performed and the best results in terms of optical contrast, were obtained for the films CN-85 and CR-39. (author).

53067 (INIS-BR–1663) **Thermoluminescent dosemeters of $CaSO_4$: Dy + Teflon.** Campos, L.L. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). [1989]. 11p. Order Number DE90606823. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The development of a pellet dosemeter of $CaSO_4$: Dy + Teflon at the Dosimetric Materials Production Laboratory - IPEN/Brazilian CNEN-SP is presented. The pellets were produced by cold pressing and sintering a mixture of $CaSO_4$: Dy and Teflon powders. The pellet characteristics from the point of view of dosimetry. A filter combination providing an energy independent response from 20 KeV to 1,25 MeV was obtained. The dosemeter consists of three pellets sealed between two thin plastic sheets and placed under plastic and lead filters. The combination of these three filters allows to determine the energy of an unknown source. (author).

53068 (INIS-mf–12006, pp. 26) **Development of the central drift chamber for the 4π detector.** Pelte, D.; Trzaska, M.; Wessels, J.; Wiemold, T.; Winkler, U.; Wolfenstaetter, H. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Two protosegments of the central drift chamber for the 4π-detector have been built and their resolutions with respect to the coordinates z and phi were measured. Several gas mixtures were tested. The development of the front-end multiprocessor system was continued and the development of Monte Carlo routines to simulate the complete data handling was started. (orig.).

53069 (INIS-mf–12006, pp. 28-29) **Readout of capacitively coupled SI strip detectors.** Kihm, T.; Knoepfle, K.T.; Seeger, M. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

We discuss the operation of a Si strip detector with each strip connected to a capacitor chain for readout at both ends. We show

quantitatively how the coupling capacities have to be chosen in order to obtain optimal linearity and resolution for both the energy and position information. (orig.).

53070 (INIS-mf–12006, pp. 29-31) **Design studies for the EUROBALL project.** Gerl, J. (Heidelberg Univ. (Germany, F.R.). Physikalisches Inst.). Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Monte Carlo simulations of the response of two designs for EUROBALL detectors have been performed. One construction aiming for maximum detection solid angle (Ge-Ball) does not yet achieve the demanded performance. The other design, a detector composed of several Ge-crystals to attain an optimum efficiency, however seems to fulfill all requirements. (orig.).

53071 (INIS-mf–12006, pp. 32-34) **Construction of a new parallel-plate detector for the crystal ball.** Schulz, E. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.)); Habs, D.; Klatt, C.; Gerl, J.; Korten, W.; Schwalm, D. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

A new generation of parallel plate counters has been built. The spatial and time resolution has been tested in a beam experiment. (orig.).

53072 (INIS-mf–12006, pp. 44) **Nuclear physics electronics.** Bulian, N.; Holoch, R.; Hornung, M.; Pelikan, P.; Roedel, R. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

The main activities have been in the fields of development and fabrication of nuclear electronics. (orig.).

53073 (INIS-mf–12006, pp. 60-63) **The Heidelberg-Moscow double beta decay experiment with enriched ^{76}Ge.** Buchner, E. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.)); Heusser, G.; Piepke, A.; Schneider, J.; Strecker, H.; Klapdor, H.V.; Kongrapenko, I.; Balish, A.; Lebedev, A.; Belyaev, S.T. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

The Heidelberg-Moscow double beta decay experiment intending to use enriched ^{76}Ge has been funded and an agreement on cooperation has been signed this year by the MPI and the Kurchatov Institute within the framework of the German-Soviet contract on cooperation in science and technology between BMFT and Atomic State Committee of the USSR. 7.5 kg of enriched material have been transferred to Heidelberg by the end of this year for detector production. In Heidelberg the work on a prototype detector and the shielding system has been continued; the development of a low-level data acquisition system and of a Monte Carlo program for background simulation studies has been started. (orig.).

53074 (INIS-mf–12006, pp. 96-97) **Beam profile monitor by the method of rest gas ionisation.** Baumann, W. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.)); Faulstich, A.; Habs, D.; Jaeschke, E.; Kraemer, D.; Petrich, W.; Welti, K.; Zwickler, S.; Berger, J.; Blatt, P. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Described is the concept of a residual gas ionization beam profile monitor for TSR. The mechanical design of the device is in progress. The horizontal profile is obtained from the spatial distribution of electrons arriving at a microchannel plate detector. The vertical profile will be derived from the arrival time of ions at an electrode in the same profile monitor unit. A spatial resolution of +- 0.85 mm and measuring times on the order of 0.1 s for histograms of good statistics are envisaged. (orig.).

53075 (INIS-mf–12006, pp. 107-108) **CERES - an electron-pair spectrometer for proton-nucleus and nucleus-nucleus collisions at the CERN SPS.** Barasch, E.F.; Breskin, A.; Chechik, R.; Drees, A.; Faschingbauer, U.; Fischer, P.; Fraenkel, Z.; Glaessel, P.; Guckes, M.; Irmscher, D. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

An experiment has been formally proposed in 1988 to measure e^+e^- pair production in hadron and nuclear collisions at SPS energies. The goal is to systematically study the pair continuum in the mass region from 100 MeV/c^2 to beyond 3 GeV/c^2 and the vector mesons rho/ω and PHI. The experimental set-up is centered around a novel magnetic spectrometer, based solely on ring-image Cherenkov techniques. The apparatus also allows a high-statistics study of real photons and high-p_t pions. (orig.).

53076 (INIS-mf–12006, pp. 110) **Set-up of a hyperon beam experiment at the CERN Omega Spectrometer.** Brueckner, W.; Doebbeling, H.; Godbersen, M.; Henkes, T.; Kallakowsky, T.; Michaels, R.; Paul, S.; Povh, B.; Roehrich, K. WA89 Collaboration. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

We are currently preparing a hyperon experiment at the CERN SPS (WA89) using the existing Omega facility. The aim of the experiment is threefold: Search for charmed strange baryons, confirmation of the exotic state U(3100) and physics with tagged hyperons, aiming at the search for the double strange dibaryon H and the study of diffractive phenomena with hyperons. The experiment will start in October 1989. (orig.).

53077 (INIS-mf–12006, pp. 111-112) **Shower detectors for the γ-astronomy at high energies.** Hofmann, W.; Mohrlok, U.; Wiedner, C.A.; Zickgraf, S.; Zimmermann, U. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

An array of some 400 detectors covering 600 by 600 m is foreseen to detect the charged secondaries from cosmic γ-rays ($E>10^{13}$). A detector module contains 2 drift chambers of 2 m^2 each, an iron absorber and scintillators. The events are recorded with the FADC system DL 300. Due to the anticipated muon-electron discrimination a clean separation of the electromagnetic showers from the hadronic background will be accomplished. Also the angular resolution will be improved compared to similar detector arrays, either planned or operating. Work has started on prototype detectors, the readout electronics and track analysis. (orig./HSI).

53078 (INIS-mf–12006, pp. 122-128) **Gallium-solar-neutrino-experiment (project 'GALLEX').** Breitenbach, M.; Burkert, E.; Doerflinger, D.; Hampel, W.; Heusser, G.; Kaether, D.; Kiko, J.; Kirsten, T.; Lalla, H.; Lenzing, A. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

The GALLEX project for solar neutrino detection continues to proceed as planned. Particular milestones achieved in 1988 are: the first arrival of 13.3 tons of high quality $CaCl_3$ target solution in the Gran Sasso Laboratory on December 7, 1988, also implying a successful practice test of analytics and transport logistics; the completion of the 250 m^2 technical outside facility (TOF) for target handling located 1 km from the tunnel entrance; the implementation and operation of two counting stations in the GALLEX Counting Building employing both, the MULIA electronics (Ground Floor Lab, GFL) and the CAMAC (Rome) data handling support (First Floor Lab, FFL); the revealing of record low background rates with HDII-Fe proportional counters in these measurements; installation of a devoted clean counter building laboratory at MPI with ongoing serial counter production; successful performance of analytical facilities, including the atomic absorption spectrometer newly installed in the GALLEX main building; measurement of ^{71}Ge and ^{69}Ge production

yields in thick target $GaCl_3$ irradiations with the CERN muon beam; on site neutron flux measurements confirming that no special neutron shield is needed for the target tank. As originally proposed, the actual full scale measurements should start at the end of 1989. (orig.).

53079 (INIS-mf–12006, pp. 131-132) **CoMA, an experiment for the detailed in-situ analysis of collected cometary particulates.** Kissel, J.; Fechtig, H.; Jessberger, E.K.; Krueger, F.R.; Niemczyk, N.; Schaefer, G.; Zscheeg, H. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

After NASA accepted for the implementation phase (up to October 1990) our proposal for the CoMA investigation to be flown onboard CRAF to rendezvous with a comet, funding by the BMFT for instrument pre-development has been obtained. Most contracts could be let, some, however, with substantial delay due to administrative problems. Progress can be reported as the group in Bremen could demonstrate a mass resolution of 60 000 for a low magnetic field ICR-experiment, resolving $^{12}CH^+$ and $^{13}C^+$ ions. Also a first successful attempt was made to theoretically describe the dust collection efficiencies of different materials. As yet such a model did not exist - a fact that made the interpretation and extrapolation of laboratory data obsolete. The experimental setup in which the Indium liquid ion source is tested could be completed by the successful addition of a bunching structure. In future it will serve those partners that develop in detail the primary beam system. (orig.).

53080 (INIS-mf–12006, pp. 137) **Measurements with rockets: Positive Ions in the polar D- and E-layer.** Steinweg, A.; Krankowsky, D.; Laemmerzahl, P.; Mauersberger, K.; Anweiler, B.; Doerflinger, D.; Dann, W.; Eller, H.; Thron, H.W. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Positive ion composition measurements with high spatial resolution were performed from Andoeya/Norway in conjunction with the radar scatter facilities EISCAT and STARE within the project ROSE. (orig.).

53081 (INIS-mf–12006, pp. 153-154) **Resonance ionization mass spectrometry with xenon.** Schneider, K.; Wunderlich, R.; Neuerburg, A.; Kirsten, T. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

A complete RIMS machine (RIMS = Resonance Ionization Mass Spectrometry) consisting of a very efficient RIS-ion source with a sensitivity of 2.5×10^{-4} A/Torr for Xe and an 'oscillator'-type time-of-flight mass spectrometer with mass resolutions up to 600 at 130 amu and very high transmissions of typically 20 to 50% has been developed. It already has been tested by use of Xe-samples with natural isotopic composition. Presently a lower limit to the element selectivity - the ratio of Xe to residual gas ions produced from the same number of atoms - of 200 is obtained. (orig.).

53082 (INIS-mf–12006, pp. 154) **Studies of a double focussing miniature mass spectrometer with focal plane.** Gehring, G.; Doerflinger, D.; Krankowsky, D.; Mauersberger, K. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

The performance of a miniature double focussing mass spectrometer with focal plane geometry was measured and compared to its design values. (orig.).

53083 (IPEN-PUB–252) **Performance of special extremity dosimeters of BeO in X and gamma radiation fields.** Caldas, L.; Graf, W.; Brand, H.N. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). May 1989. 13p. (In Portuguese). Order Number DE90606800. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A dosimetric system, projected and constructed at the Institut fur Strahlenschutz, consisting of a thermoluminescent reader and BeO one-way dosemeters incorporated in metallic holders, for use extremities, was tested in the presented work in relation to its most important characteristics: detection threshold, response linearity to ^{60}Co radiation, thermal fading at 50^0C and energy dependence for X-radiation (from 15 to 300 kV) and gamma radiation (^{60}Co and ^{137}Cs). The influence, on the dosemeter response, of an opaque plastic cover was also studied. The results show that the system can be very useful in individual monitoring, with many advantages in relation to other commercially available dosemeters. (author).

53084 (IPNO-DRE–88-41) **Study and performances of the SPES III detector.** Comets, M.P.; Le Bornec, Y.; Loireleux, E.; Tatischeff, B.; Willis, N.; Boivin, M. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1988. 40p. (In French). Order Number DE90713789. Available from NTIS (US Sales Only), PC A03/MF A01.

A study of the performances of the spectrometer SPES 3 at the Saturn synchroton is presented. The work is done with the data taken in a run. The different methods to make the data set coherent are presented. The chamber resolutions are determined. The width of the peaks in the missing mass spectra is measured. SPES 3 allows analysis of the particles scattered at 0 deg.

53085 (LBL–27581) **A method for measuring the time structure of synchrotron x-ray beams.** Moses, W.W.; Derenzo, S.E. Lawrence Berkeley Lab., CA (USA). Aug 1989. 11p. Sponsored by U.S. DOE Energy Research; U.S. Department of Health and Human Services. DOE Contract AC03-76SF00098. PO1HL25840;RO1CA38086. (CONF-890802–1: 7. synchrotron radiation instrumentation (SRI) national conference, Berkeley, CA (USA), 6-10 Aug 1989). Order Number DE90001422. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

We describe a method employing a plastic scintillator coupled to a fast photomultiplier tube to generate a timing pulse from the x-ray bursts emitted from a synchrotron radiation source. This technique is useful for performing synchrotron experiments where detailed knowledge of the timing distribution is necessary, such as time resolved spectroscopy or fluorescence lifetime experiments. By digitizing the time difference between the timing signal generated on one beam crossing with the timing signal generated on the next beam crossing, the time structure of a synchrotron beam can be analyzed. Using this technique, we have investigated the single bunch time structure at the National Synchrotron Light Source (NSLS) during pilot runs in January, 1989, and found that the majority of the beam (96%) is contained in one rf bucket, while the remainder of the beam (4%) is contained in satellite rf buckets preceeding and following the main rf bucket by 19 ns. 1 ref., 4 figs.

53086 (LBL–27620) **The HISS TPC.** Rai, G.; Bieser, F.; Matis, H.S.; McParland, C.; Odyniec, G.; Olson, D.L.; Pugh, H.G.; Ritter, H.G.; Symons, T.J.M.; Wieman, H. Lawrence Berkeley Lab., CA (USA). Aug 1989. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-8905143–18: NATO advanced study institute international advanced course on the nuclear equation of state, Peniscola (Spain), 12 May - 3 jun 1989). Order Number DE90000557. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This paper discusses the design, development and application of the HISS time projection chambers. (LSP)

53087 (N–89-25051) **Position-sensitive CdTe detector using improved crystal growth method. Final report.** San Diego Supercomputer Center, CA (USA). Sep 1988. 27p. (NASA-CR–183427;NAS–1.26:183427). Available from NTIS, PC A03/MF A01.

The feasibility of developing a position-sensitive CdTe detector array for astronomical observations in the hard X-ray, soft gamma ray region is demonstrated. In principle, it was possible to improve the resolution capability for imaging measurements in this region by orders of magnitude over what is now possible through the use of CdTe detector arrays. The objective was to show that CdTe crystals of the quality, size and uniformity required for this application can

be obtained with a new high pressure growth technique. The approach was to fabricate, characterize and analyze a 100 element square array and several single-element detectors using crystals from the new growth process. Results show that detectors fabricated from transversely sliced, 7 cm diameter wafers of CdTe exhibit efficient counting capability and a high degree of uniformity over their entire areas. A 100 element square array of 1 sq mm detectors was fabricated and operated.

53088 (ORNL/FTR–2454) **[Wall and zero-degree calorimeters]: Foreign trip report, November 3, 1985–December 1, 1986.** Cumby, R.P. Oak Ridge National Lab., TN (USA). 8 Dec 1986. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89017278. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler participated in stacking of the Wall Calorimeter, installing light guides, and installing photomultiplier tubes and checking each. He also assisted with installation of light guides and photomultiplier tubes on the Zero-Degree Calorimeter that was stacked at ORNL.

53089 (ORNL/FTR–3374) **[Design, construction, and operation of a detector to be used on the SSC]: Foreign trip report, September 7, 1989–September 9, 1989.** Trivelpiece, A.W. Oak Ridge National Lab., TN (USA). 20 Sep 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90001258. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Traveler met with Dr. Sam Ting, leader of the L-3 Detector Group on the Lep accelerator at CERN to discuss possible collaboration involving the Oak Ridge National Laboratory in the design, construction, and operation of a detector to be used on the SSC. Traveler also met with country leaders involved in the L-3 activities, and interviewed several physicists working on the project as candidates to come to ORNL and work on the new detector.

53090 (ORNL/FTR–3408) **[Data acquisition for Ge detector arrays]: Foreign trip report, September 9, 1989–September 30, 1989.** Hensley, D.C. Oak Ridge National Lab., TN (USA). 9 Oct 1989. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90001495. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler presented three invited lectures entitled "An Overview of Data Acquisition for Ge Detector Arrays," "Specialized Data Acquisition for Ge Detector Arrays," and "Gamma-Ray Angular Correlations from Heavy-Ion Inelastic Scattering Measured in the Spin Spectrometer" and acted as a Study Group Coordinator at the Nuclear Structure in the Era of New Spectroscopy Workshop in Copenhagen, Denmark.

53091 (RAL–89-056) **Electronics readout system for the OPAL Vertex Drift Chamber.** Carter, A.A.; Lloyd, S.L.; Pritchard, T.W.; Carter, J.R.; Hill, J.C.; Matson, R.M.; Milborrow, R.S.; Jeffs, M.D.; White, D.J. Rutherford Appleton Lab., Chilton (UK). Jun 1989. 24p. Order Number DE90606821. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The Vertex Drift Chamber for the OPAL experiment at LEP provides high quality track co-ordinates using multi-hit sub-nanosecond timing to detect the drifted electrons. This paper explains the electronic techniques that have been devised and implemented for the detector. The overall performance of the system is demonstrated with measurements from the final OPAL chamber. (author).

53092 **A method for picosecond lifetime measurements for neutron-rich nuclei. Pt. 1. Outline of the method.** Mach, H. (Clark Univ., Worcester, MA (USA)); Gill, R.L.; Moszynski, M. *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands),* 280(1): 49-72 (1 Aug 1989). DOE Contract AC02-79ER10493;AC02-76CH00016.

A general method of nuclear level lifetime measurements in the low-picosecond range for neutron-rich nuclei is proposed. This new method, designed for use at fission product mass separators, is based on standardized detector systems and procedures, and a comprehensive approach to data analysis for the whole decay scheme. Measurement utilize β-γ-γ coincidence where the fast timing information is derived from β-γ coincidence in timing detectors while the selection of the desired decay branch is obtained by using coincident γ-transition recorded in a Ge detector with high energy resolution. The key idea is to use a thin ΔE-β-detector to provide a uniform timing response for energetic betas. A BaF_2 crystal is used as the timing γ-detector due to its superior energy resolution and efficiency in comparison to fast plastic scintillators. The outline of the method, which includes the experimental set-up and general techniques of data analysis, is dicussed. A number of lifetime measurements in the subnanosecond range are presented to show the high selectivity of the method in identifying delayed γ-transitions. (orig.).

53093 **The assessment of geometrical effects on Compton profile measurements.** Gigante, G.E. (Rome-1 Univ. (Italy)); Hanson, A.L. *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands),* 280(2/3): 299-300 (10 Aug 1989). DOE Contract AC02-76CH00016. (CONF-881020–: 4. international symposium on radiation physics (ISRP-4), Sao Paulo (Brazil), 3-7 Oct 1988).

Energy-dispersive measurements of Compton-scattered X-rays for analyses have become important with the development of high-efficiency, high-energy-resolution detectors for 50-200 keV X-rays. The Compton-scattered X-ray peak is an inherently broad peak resulting in part from the momentum distribution of the target electrons, referred to as the Compton profile. Hence, information from the width of the Compton peak can be used to study the momentum distribution. The actual peak width also depends on geometrical and attenuation effects. We have begun to assess the geometrical effects and present some of the results. (orig.).

53094 **Elemental concentrations from thermal capture gamma-ray spectra in geological formations.** Grau, J.A.; Schweitzer, J.S. *Transactions of the American Nuclear Society (USA),* 56: 255-256 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The problem discussed in this paper is the method of obtaining the most accurate elemental decomposition of neutron-induced gamma-ray spectra measured by a NaI(T1) detector in a subsurface environment. It is generally accepted that if the composite spectrum measured in the well can be correctly represented by a linear combination of known standard spectra, then the method of weighted least-squares (WLS) differences produces the most precise result. Previous work has established the basis for applying these techniques to thermal neutron capture spectra. More detailed studies, to ensure the validity of the linear composition assumption under all conditions of potential spectral distortion, have led to a recognition of the need for a more complete set of spectral standards to properly account for all significant spectral contributions. The spectrometer uses a pulsed accelerator to produce 14-MeV neutrons and is part of a set of spectrometers specifically designed to provide elemental concentrations of subsurface formations.

53095 **Efficiency and resolution of a new readout system for electro-optical devices.** Dunham, M.E. (EG&G Energy Measurements, Inc., Los Alamos Operations, P. O. Box 809, Los Alamos, New Mexico 87544 (US)). *Review of Scientific Instruments (USA),* 60(9): 2915-2919 (Sep 1989).

Results of a new experiment investigating fiber-coupled, astronomical CCD cameras as imaging systems for electro-optic devices are described. These results indicate that single-electron detection is achievable at 10-kV energy and that the resolution can exceed 35-μm FWHM. A system using such a camera to read a matched, high-resolution phosphor is described, and characterizations of the various component efficiencies are given. It is concluded that this system offers formidable competition to microchannel plate intensified systems with respect to dynamic range, absolute sensitivity, and cost.

53096 **Measuring axially varying beam position using *B*-dot monitors.** Shokair, I.R. (Plasma Theory Division, Sandia National Laboratories, Albuquerque, New Mexico 87185 (US)). *Review of Scientific Instruments (USA),* 60(9): 2969-2974 (Sep 1989). DOE Contract AC04-76DP00789.

For charged-particle beam experiments, it is often necessary to measure the transverse position of a beam that is undergoing oscillations as it propagates axially in a conducting tube. This is usually done using small wire loops called *B*-dot monitors which measure the change of magnetic flux. If the monitors are located at a radius *R*, which is of the same order as the wavelength of the beam oscillations, the *B*-dot signal and the beam transverse position are related in a nonlocal manner. We consider this situation here and derive an integral equation relating the beam position to the *B*-dot signals, for arbitrary displacement profiles, in the limit of small beam displacements. Solutions of this equation are obtained for special cases along with a numerical method for solving the general problem.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

Refer also to citation(s) 52109, 52559, 52636, 52655, 52955, 53131

53097 (N–89-23547, pp. 597-605) **Working group written presentation: Trapped radiation effects.** Vampola, A.L. (National Aeronautics and Space Administration, Langley Research Center, Hampton, VA (USA)); Stuckey, W.K.; Coulter, D.; Friebele, E.J.; Hand, K.J.; Hardy, D.A.; Higby, P.; Kolasinski, W.A.; Santoro, R.T.; Tompkins, S.S. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. May 1989. (NASA-CP–3035-PT-2;L–16575-PT-2;NAS–1.55:3035-PT-2;CONF-8806434–: NASA/SDIO space environmental effects on materials workshop, Hampton, VA (USA), 28 Jun - 1 jul 1988). In *NASA/SDIO Space Environmental Effects on Materials Workshop, part 2.* Available from NTIS, PC A12/MF A01.

The results of the Trapped Radiation Effects Panel for the Space Environmental Effects on Materials Workshop are presented. The needs of the space community for new data regarding effects of the space environment on materials, including electronics are listed. A series of questions asked of each of the panels at the workshop are addressed. Areas of research which should be pursued to satisfy the requirements for better knowledge of the environment and better understanding of the effects of the energetic charged particle environment on new materials and advanced electronics technology are suggested.

53098 (SAND–89-2011C) **200 MeV, fast neutron and gamma ray effects on AlGaAs/GaAs HEMTs [high electron mobility transistors].** Loescher, D.H.; Pyo, M.L. Sandia National Labs., Albuquerque, NM (USA). [1989]. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-891159–2: GOMAC '89: government microcircuit applications conference, Orlando, FL (USA), 7-9 Nov 1989). Order Number DE90001175. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper reports the changes caused by fast neutrons and 200 MeV protons in the electrical properties of high electron mobility transistors (HEMT). A larger gate voltage was required after irradiation with neutron fluences in the 1E14 to 2E15 n/cm^2 range and 200 MeV proton fluences in the 1E14 to 1E15 p/cm^2 range than was required prior to irradiation to obtain the same value of I_{ds}. The increase in gate voltage required to compensate for a fluence of 1E15 protons/cm^2 was up to four times as great as that required to compensate for the same fluence of neutrons. All devices showed microwave gain (s21) after exposure to 6E14 particles/cm^2 if the gate bias was adjusted to maintain the pre-irradiation value of I_{ds}. Gamma irradiation at 5E7 rads(GaAs) had no detectable effect on the devices. 8 refs., 6 figs., 1 tab.

53099 Neutron hardness of silicon-based semiconductor devices. Baratta, A.J.; Kenney, E.S. *Transactions of the American Nuclear Society (USA),* 56: 130-131 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The effects of radiation on silicon-based semiconductor devices have been the subject of research for many years. In an effort to understand these effects, a series of experiments was conducted on gamma-hardened MOSFETs. Experiments concentrated on MOSFETs in rad-hard form and on off-the-shelf items. Because of the need to maintain bias voltages at set levels to enhance damage and because of concerns over possible rapid annealing, active testing during irradiation was performed. In general, MOSFETs are expected to perform well in fast neutron environments. With the advances in rad-hard technologies, exposures to several-megarad gamma rays can be tolerated. In nuclear systems, the normal concurrent neutron fluence can reach over 10^{16} n/cm^2. At these levels, current research indicates that the devices fail. Such failure is not altogether unexpected, although the degree of induced structural disorder in the semiconductor's crystalline makeup is still small. However, the damage done appears to carry the silicon back to a nearly intrinsic state. Knowing that each primary knock-on atom causes 10 to 6000 secondary atomic dislocations, the fluences of 10^{16}/cm^2 are clearly at a level able to markedly change semiconductor dopant-induced behavior. Thus, one can conclude that for current devices, the gamma dose in a mixed neutron gamma field may no longer be limiting.

53100 Neutron effects in GaAs devices. Chang, J.Y.; Badawi, M.H. *Transactions of the American Nuclear Society (USA),* 56: 131-133 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

It has long been recognized that exposure of gallium arsenide (GaAs) devices to nuclear radiation results in charge carrier removal and carrier mobility reduction and that these effects are responsible for the observed degradation in device electrical performance. For a given exposure to neutrons and/or gamma rays, the degree of device degradation can be quantitatively determined through measurement of several parameters during dc operation of the device (dc parameters). These include the pinch-off voltage V_p, the drain-source saturation current I_{dss}, and the transconductance g_m. Changes in the dc parameters in turn can be related to changes in the carrier concentration N an carrier mobility μ through existing models. Based on the assumption that neutron irradiation produces primarily displacement defects, while gamma exposure results mainly in ionization, the authors developed an experimental approach to help analyze the evolution in N and μ and their interrelationship under progressively larger neutron exposures. Part of the models to higher neutron fluences. The approach featured partial annealing after neutron exposure, in turn followed by gamma irradiation.

53101 Transient radiation effects in GaAs semiconductor devices. Chang, J.Y.; Stauber, M.; Ezzeddine, A.; Howard, J.W.; Constantine, A.G.; Becker, M.; Block, R.C. *Transactions of the American Nuclear Society (USA),* 56: 133-135 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

This paper describes an ongoing program to identify the response of GaAs devices to intense pulses of ionizing radiation. The program consists of experimental measurements at the Rensselaer Polytechnic Institute's RPI electron linear accelerator (Linac) on generic GaAs devices built by Grumman Tachonics Corporation and the analysis of these results through computer simulation with the circuit model code SPICE (including radiation effects incorporated in the variations TRISPICE and TRIGSPICE and the device model code PISCES IIB). The objective of this program is the observation of the basic response phenomena and the development of accurate simulation tools so that results of Linac irradiations tests can be understood and predicted.

53102 Modeling and simulation of interactions of transient ionizing radiation with electronics. Ishaque, A.N.; Howard, J.W.; Becker, M.; Block, R.C. *Transactions of the American Nuclear Society (USA),* 56: 136 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Electronic devices frequently are designed to withstand environments in which transient ionizing radiation may be present. Devices so designed must be tested to determine whether they indeed can withstand such radiation. Electron linear accelerators, including Rensselaer Polytechnic Institute's (RPI) Linac, are used for such testing. To understand the interactions that take place, it is desirable to model and simulate the phenomena involved. At RPI, there is an ongoing effort in modeling and simulation to complement and support the experimental program at the Linac. Modeling and simulation at RPI is directed toward predicting the types of radiation effects that occur when transient measurements are made at the

RPI Linac. The combination of device and circuit modeling provides both insight and confidence in the merits of the models developed.

53103 Laboratory simulation of cosmic-ray-induced upset in microelectronics. Pickel, J.C. *Transactions of the American Nuclear Society (USA),* 56: 136-137 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The continuing evolution of integrated microelectronic circuits toward higher density has resulted in smaller feature sizes and fewer electronic charges representing an information bit. These highly integrated circuits are now subject to the phenomenon of single event upset (SEU) caused by ionization from individual particles in the natural radiation environment. A quantity of charge comparable to that representing a data bit can be generated by a single ionizing particle and collected on a circuit node, resulting in a change in the binary state of a memory latch and a logic error for the memory chip. In most cases, the logic error is permanent only in the sense that the information has been destroyed; the physical device is undamaged and may be reprogrammed without further consequence. In some technologies, permanent damage to the device can be induced by a single particle. Because spacecraft system designers require information about the expected in-orbit SEU rate for potential microelectronic devices in order to accomplish successful system design, there is a continuing need for laboratory simulation of SEU. The SEU testing consists of irradiating a device with a prescribed heavy ion or proton beam of known energy and flux, such that the number of upsets can be detected as a function of beam fluence and particle linear energy transfer.

53104 Radiation effects in HgCdTe IR detectors. Bass, R.; Kalma, A.H. *Transactions of the American Nuclear Society (USA),* 56: 137-140 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The HgCdTe photodiodes are an attractive choice for space surveillance infrared (IR) systems, since these detectors can achieve high levels of performance at elevated temperatures, thereby reducing cooling requirements. Such sensors are also required to operate and survive in the natural and weapon-enhanced space environment. For this reason, radiation effects in HgCdTe IR detectors is an active area of investigation. The authors report here the current level of understanding of total-dose and persistent-dose-rate effects. Neutron-induced damage is not discussed as the intrinsic density of defects in HgCdTe is so high that neutron sources that could cause a significant change in detector properties are currently not available. Prompt pulse effects are similarly not discussed as hardness against prompt pulse upset is accomplished at the sensor level and is not a driver in detector technology development. No evidence has yet been shown of permanent prompt pulse response in HgCdTe detectors. The HgCdTe appears to have a promising future for MWIR space surveillance applications as long as adequate noise mitigation methods can be developed to deal with the persistent-dose-rate effects. Actual hardening investigations of LWIR photovoltaic arrays have not really been undertaken yet; such advances that have occurred have been the side products of developments addressed for other reasons.

4403 Miscellaneous Instruments

Refer also to citation(s) 51905, 52595, 52865, 52898, 52991, 53414, 54053

53105 (AD-A–209356/5/XAB) **High-temperature tribometer. Phase 1. Final report, 8 September 1988-7 March 1989.** Carignan, F.J.; Knoth, B.H. Advanced Mechanical Technology, Inc., Newton, MA (USA). Jun 1989. 81p. (AMTI–2236-1). Available from NTIS, PC A05/MF A01.

Tribological research has become more important due to the awareness that friction and wear accounts for a large portion of our nation's energy and raw material usage. A machine is available that performs pin-on-disk friction and wear tests at temperatures up to 1200 C. Software to control the machine and acquire test data using IBM-PC compatible computers was designed and developed and initial tests of the software were conducted. A commercial software package, Labtech Notebook, was used as the basis for the system, although unique data-acquisition and graphics modules were also developed. A piston-type liquid lubricant feed pump was chosen for accurately dispensing small quantities of test lubricant. A prototype of a solid powder feed system was built and functioned well with granular material but unsatisfactorily with the two very fine powders.

53106 (BNL–42943) **Bragg reflection transmission filters for variable resolution monochromators.** Chapman, D. Brookhaven National Lab., Upton, NY (USA). 1989. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890802–12: 7. synchrotron radiation instrumentation (SRI) national conference, Berkeley, CA (USA), 6-10 Aug 1989). Order Number DE90001547. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

There are various methods for improving the angular and spectral resolution of monochromator and analyzer systems. The novel system described here, though limited to higher x-ray energies (>20keV), is based on a dynamical effect occurring on the transmitted beam with a thin perfect crystal plate set in the Bragg reflection case. In the case of Bragg reflection from a perfect crystal, the incident beam is rapidly attenuated as it penetrates the crystal in the range of reflection. This extinction length is of the order of microns. The attenuation length, which determines the amount of normal transmission through the plate is generally much longer. Thus, in the range of the Bragg reflection the attenuation of the transmitted beam can change by several orders of magnitude with a small change in energy or angle. This thin crystal plate cuts a notch in the transmitted beam with a width equal to its Darwin width, thus acting as a transmission filter. When used in a non-dispersive mode with other monochromator crystals, the filter when set at the Bragg angle will reflect the entire Darwin width of the incident beam and transmit the wings of the incident beam distribution. When the element is offset in angle by some fraction of the Darwin width, the filter becomes useful in adjusting the angular width of the transmitted beam and removing a wing. Used in pairs with a symmetric offset, the filters can be used to continuously adjust the intrinsic angular divergence of the beam with good wing reduction. Instances where such filters may be useful are in improving the angular resolution of a small angle scattering camera. These filters may be added to a Bonse-Hart camera with one pair on the incident beam to reduce the intrinsic beam divergence and a second pair on the analyzer arm to improve the analyzer resolution. 2 refs., 3 Figs.

53107 (BNL–43247) **REFLECT: A computer program for the x-ray reflectivity of bent perfect crystals.** Etelaeniemi, V.; Suortti, P.; Thomlinson, W. Brookhaven National Lab., Upton, NY (USA). Sep 1989. 19p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. Order Number DE90001266. Available from NTIS, PC A03/MF A01; OSTI; INIS.

The design of monochromators for x-ray applications, using either standard laboratory sources on synchrotron radiation sources, requires a knowledge of the reflectivity of the crystals. The reflectivity depends on the crystals used, the geometry of the reflection, the energy range of the radiation, and, in the present case, the cylindrical bending radius of the optical device. This report is intended to allow the reader to become familiar with, and therefore use, a computer program called REFLECT which we have used in the design of a dual beam Laue monochromator for synchrotron angiography. The results of REFLECT have been compared to measured reflectivities for both bent Bragg and Laue geometries. The results are excellent and should give full confidence in the use of the program. 6 refs.

53108 (BNL–43316) **Critical comparison of soft x-ray fluorescence detectors for XAFS studies in the 2 to 4 keV region.** Fischer, D.A.; Yang, C.Y. Brookhaven National Lab., Upton, NY (USA). 1989. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890802–3: 7. synchrotron radiation instrumentation (SRI) national conference, Berkeley, CA (USA), 6-10 Aug 1989). Order Number DE90001559. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

We report a performance comparison of fluorescence detectors for XAFS in the soft x-ray region. In particular this comparison was made under the practical constraints of an existing hard x-ray beamline (X-19A NSLS) double Si(111) crystal monochromator with a 10 mil beryllium exit window. A critical comparison of an energy

dispersive proportional counter and an ionization chamber was performed above the sulfur K edge for a very dilute sample and a mixed element system. Third harmonic contributions and signal to background are discussed with the conclusion that an energy dispersive proportional counter provides superior results under our beamline constraints. 7 refs., 4 figs.

53109 (BNL–43327) **A scanning photoelectron microscope (SPEM) at the National Synchrotron Light Source (NSLS).** Ade, H.; Kirz, J.; Hulbert, S.; Johnson, E.; Anderson, E.; Kern, D. Brookhaven National Lab., Upton, NY (USA). 1989. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890809–2: 9. international conference on vacuum ultraviolet radiation physics, Honolulu, HI (USA), 14-18 Aug 1989). Order Number DE90001551. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

We are in the process of developing and commissioning a scanning photoelectron microscope (SPEM) at the X1A beamline of the National Synchrotron Light Source (NSLS). It is designed to make use of the Soft X-ray Undulator (SXU) at the NSLS. This high brightness source illuminates a Fresnel zone plate, which forms a focused probe, { <=} 0.2μm in size, on the specimen surface. A grating monochromator selects the photon energy in the 400-800 eV range with an energy resolution of better than 1 eV. The expected flux in the focus is in the 5 x 10^7 – 10^9 photons/s range. A single pass Cylindrical Mirror Analyzer (CMA) is used to record photoemission spectra, or to form an image within a fixed electron energy bandwidth as the specimen is mechanically scanned. As a first test, a 1000 mesh Au grid was successfully imaged with a resolution of about 1μm and the CMA tuned to the Au 4 f photoelectron peak. Once it is commissioned, a program is planned which will utilize the microscope to study beam sensitive systems, such as thin oxide/sub-oxide films of alumina and silica, and ultimately various adsorbates on these films. 14 refs., 4 figs.

53110 (BNL–43337) **An ultra-high-vacuum multiple grating chamber and scan drive with improved grating change.** Hulbert, S.L.; Holly, D.J.; Middleton, F.H.; Wallace, D.J. Brookhaven National Lab., Upton, NY (USA). [1989]. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890802–10: 7. synchrotron radiation instrumentation (SRI) national conference, Berkeley, CA (USA), 6-10 Aug 1989). Order Number DE90001554. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

We describe a new grating chamber and scan drive which has been designed, built, and tested by Physical Sciences Laboratory of the University of Wisconsin for the new high flux, high-resolution spectroscopy branch line of the TOK hybrid wiggler/undulator on the NSLS VUV ring. The chamber will contain spherical gratings to be used in the Spherical Grating Monochromator (SGM) configuration introduced by Chen and Sette. The grating chamber houses five 180 mm x 35 mm x 30 mm gratings capable of scanning a range of 12° (–14° to +8° with respect to the incoming beam direction) for VUV and soft X-ray diffraction. The gratings can be switched and precisely indexed while under ultra-high vacuum (UHV) at any scan angle and are mechanically isolated from the vacuum chamber to prevent inaccuracies due to chamber distortions. The gratings can separately be adjusted for height, yaw, pitch, and roll, with the latter three performed while in vacuo. The scan drive provides a resolution of 0.03 arc sec with linearity over the 12° range of ≈1.5 arc sec and absolute reproducibility of 1 arc sec. 5 refs., 5 figs.

53111 (BNL–43339) **Scanning Photoelectron Microscope (SPEM) with a zone plate generated microprobe.** Ade, H.; Kirz, J.; Hulbert, S.; Johnson, E.; Anderson, E.; Kern, D. Brookhaven National Lab., Upton, NY (USA). 1989. 14p. Sponsored by U.S. DOE Energy Research; National Science Foundation. DOE Contract AC02-76CH00016;AC03-76SF00098. (CONF-890802–11: 7. synchrotron radiation instrumentation (SRI) national conference, Berkeley, CA (USA), 6-10 Aug 1989). Order Number DE90001552. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

We describe instrumentation of a scanning photoelectron microscope (SPEM), which we are presently developing and commissioning at the X1A beamline of the National Synchrotron Light Source (NSLS). This instrument is designed to use the Soft X-ray Undulator (SXU) at the NSLS as a high brightness source to illuminate a Fresnel zone plate, thus forming a finely focused probe, $\leq$ 0.2μm in size, on the specimen surface. A grating monochromator selects the photon energy in the 400-800 eV range with an energy resolution better than 1 eV. The expected flux in the focus is in the 5 x 10^7 – 10^9 photons/s range. A single pass Cylindrical Mirror Analyzer (CMA) is used to record photoemission spectra, or to form an image within a fixed electron energy bandwidth as the specimen is mechanically scanned. As a first test, a 1000 mesh Au grid was successfully imaged with Au 4 f primary photoelectrons, achieving a resolution of about 1μm. 10 refs., 5 figs., 1 tab.

53112 (NAL-TR–961) **Statiscal characteristics of measurement noise included in DME output. Compatibility check with doppler radar output.** Ono, Koji. National Aerospace Lab., Chofu, Tokyo (Japan). Feb 1988. 16p. (In Japanese). Order Number DE89772374. Available from NTIS (US Sales Only), PC A03/MF A01.

VOR and DME data can be accurate enough for the purpose of navigation. The accuracy is, however, not satisfactory for the analysis of flight test data, and must be improved by the combined use of other sensor systems. The result of the experiment carried out to clarify and model the statistical characteristics of noises contained in the DME output is reported. The statistical characteristics of noises in DME data were studied by flight tests using two DME systems and one Doppler radar system currently installed in VSRA (variable stability and response airplane). 2 residuals are obtained by a compatibility check of the data of the 2 DME and 1 Doppler radar, and the statistical characteristics of noises contained in the DME data and Doppler radar data can be separately identified. 23 references, 11 figures, 1 table.

53113 (ORNL/TM–11287) **Maintenance Information and Data Acquisition System (MIDAS).** Stansberry, C.T.; Odom, S.M.; Martin, C.D. Oak Ridge National Lab., TN (USA). Sep 1989. 171p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90002095. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

The Maintenance Information Data Acquisition System (MIDAS) is an innovative program to combine new and existing programs into one unique system that allows quick response to a wide range of management information programs, leading to more effective administration of the Maintenance Management Department of the Instrumentation and Controls Division at Oak Ridge National Laboratory. The goal of this system is to provide rapid access to broad areas of management programs as easily as possible. Doing so with the touch of a single computer key thus lives up to the Midas legend, the "Golden Touch."

53114 (ORNL/TM–11321) **Initial effects of nuclear weapon x-radiation on the LAMPSHADE orbital debris satellite shield.** Smith, M.S.; Santoro, R.T. Oak Ridge National Lab., TN (USA). Sep 1989. 17p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OR21400. Order Number DE90000991. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

One-dimensional thermal-hydrodynamic calculations have been carried out to estimate the response of the lead bumper plate and tantalum liquidation screen of the LAMPSHADE orbital debris satellite shield. The mass loss fraction in the solid, liquid, and vapor phases as a function of time after irradiation for several typical incident x-ray spectra fluences were calculated using the PUFF-TFT code. The material losses did not exceed 2% and fracture and spallation were confined to the surface region with no apparent reduction in the performance of these components against incident debris. 4 refs., 5 figs., 3 tabs.

53115 (SAND–89-0761) **The phase gradient autofocus algorithm: An optimal estimator of the phase derivative.** Eichel, P.H. Sandia National Labs., Albuquerque, NM (USA). Sep 1989. 16p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE90000895. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The phase gradient algorithm represents a powerful new signal processing technique with applications to aperture synthesis imaging. These include, for example, synthetic aperture radar phase correction and stellar image reconstruction. The algorithm combines

redundant information present in the data to arrive at an estimate of the phase derivative. In this report, we show that the estimator is in fact a linear, minimum variance estimator of the phase derivative. 7 refs.

53116 (SAND–89-1423C) **A radar simulation program for a 1024-processor hypercube.** Gustafson, J.L.; Benner, R.E.; Sears, M.P.; Sullivan, T.D. Sandia National Labs., Albuquerque, NM (USA). [1989]. 16p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-891149–3: Supercomputing '89 conference, Reno, NV (USA), 13-17 Nov 1989). Order Number DE89014494. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We have developed a fast parallel version of an existing synthetic aperture radar (SAR) simulation program, SRIM. On a 1024-processor NCUBE hypercube it runs an order of magnitude faster than on a CRAY X-MP or CRAY Y-MP processor. This speed advantage is coupled with an order of magnitude advantage in machine acquisition cost. SRIM is a somewhat large (30,000 lines of Fortran 77) program designed for uniprocessors; its restructuring for hypercube provides new lessons in the task of altering older serial programs to run well on modern parallel architectures. We describe the techniques used for parallelization, and the performance obtained. Several novel parallel approaches to problems of task distribution, and direct output were required. These techniques increase performance and appear to have general applicability for massive parallelism. We describe the hierarchy necessary to dynamically manage (i.e., load balance) a large ensemble. The ensemble is used in a heterogeneous manner, with different programs on different parts of the hypercube. The heterogeneous approach takes advantage of the independent instruction streams possible on MIMD machines. 18 refs., 7 figs., 4 tabs.

53117 (UCRL–99801) **Realtime tracking system for wide-field-of-view telescope.** Park, Hye-Sook. Lawrence Berkeley Lab., CA (USA). 21 Aug 1989. 4p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-48. (CONF-8910196–2: Electronic imaging '89, Boston, MA (USA), 2-5 Oct 1989). Order Number DE90001147. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We are constructing a wide-field-of-view telescope with smart focal plane processors that recognize moving objects in the field-of-view and tracks them with high resolution. The telescope lens is made of concentric blocks of glass viewing a 60 degree field-of-view. Intensified CCD cameras on the focal plane acquire images which are processed by a Datacube image processor. The system views the night sky, extracts the position and intensity of stars, and recognizes and tracks any artificial satellites which move through the field-of-view. 3 figs.

53118 (UCRL–101137) **Environmental collaborations in the use of Accelerator Mass Spectrometry.** Davis, J.C.; Finkel, R.C. Lawrence Livermore National Lab., CA (USA). 10 Aug 1989. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8907103–9: Technology-based confidence building: energy and environment, Santa Fe, NM (USA), 9-14 Jul 1989). Order Number DE90000782. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Accelerator Mass Spectrometry (hereafter AMS) is a technique for analyzing extremely low levels of radionuclides. The technique was first demonstrated slightly over a decade ago at three laboratories virtually simultaneously. In the usual implementation of this analytical technique, a beam of ions containing both the rare isotope of interest and the more abundant stable isotopes is accelerated to high energy using a tandem Van de Graaff accelerator. A combination of electron stripping at high velocities (which destroys all molecular species) and redundant magnetic, electrostatic and energy analysis allows one to measure rare to stable isotope ratios as low as $1:10^{16}$. The layout of the system implemented at LLNL is shown in Figure 1. As the rare isotopes are identified by particle counting, rather than by waiting for their decay, one may assay small samples for very low concentrations of long-lived nuclides. This ability to do single atom detection independent of the half-life of the isotope has allowed AMS to extend the applicability of many research areas that use isotopic tracers. At present, there are approximately 20 accelerator facilities world-wide where such measurements are possible. In general, each accelerator has other missions in nuclear research, making available only a limited amount of time for AMS analyses. There are two dedicated facilities in North America, one at the University of Toronto and one at the University of Arizona, specializing primarily in radiocarbon dating. 6 refs.

53119 (WSRC-RP–89-463) **Software for instrument control at the Savannah River site.** Buchanan, B.R.; O'Rourke, P.E. Westinghouse Savannah River Co., Aiken, SC (USA). 1989. 13p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-891192–2: Annual Westinghouse computer symposium, Pittsburgh, PA (USA), 6-7 Nov 1989). Order Number DE89017867. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Diode Array Spectrophotometry (DAS) is used extensively at the Savannah River Site. The instruments are operated both in the laboratory and on-line at actual site processes. This requires that special software packages be coded to operate the instruments. Also, chemometrics, a branch of chemistry dealing with mathematical modeling, must be performed on the spectra to obtain concentration values. This requires that data from standards be obtained, stored, and analyzed. Modular software to control a variety of instruments in both interactive and automatic modes will be presented. 2 refs., 7 figs.

53120 **Signal processing for an infrared array detector.** Young, M.A. (Laboratory of Chemical Biodynamics, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720 (US)); Smith, G.E.; Fimentel, G.C. *Review of Scientific Instruments (USA),* 60(9): 2920-2923 (Sep 1989). DOE Contract AC03-76SF00098.

A broadband detection scheme for a time-resolved infrared absorption spectrometer, based on a multielement mercury-cadmium-telluride (MCT) array, has been successfully implemented. The spectrometer achieves a resolution on the 10-ns time scale despite the much larger time constant characteristic of the MCT elements. Our signal-collection circuitry takes advantage of the slow decay by integrating the detector response to pulsed IR radiation. The dynamic range is 100–1 and the resultant noise level is near the detector limit. Data acquisition for the 120 elements is fast enough to allow scan rates of 30–40 Hz. The completed electronics are sufficiently compact to be situated local to the array detector, and the design is relatively inexpensive to construct using commonly found electronic components.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

53121 (AD-A–209184/1/XAB) **Laboratory-scale airblast precursor experiments. Volume 3. HOB (height of burst) studies micro-mach experiments. Technical report.** Reichenbach, H. Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Freiburg im Breisgau (Germany, F.R.). Ernst-Mach-Inst. 31 Mar 1989. 81p. Available from NTIS, PC A05/MF A01.

If a blast wave propagates in a medium where a thin layer of high-temperature gas is located near the ground, a precursor develops. This work was undertaken to increase the understanding of the fluid dynamics of airblast precursors. A series of shock-tube experiments were conducted using a helium layer from a porous plate and a heated plate to create a surficial high-sound-speed layer. A series of small charge tests were conducted in an enclosed environment using a helium-induced high-sound-speed layer introduced from a circularly symmetric ceramic porous plate.

53122 (MLM–3606(OP)) **Development of a titanium/boron blending process.** Love, C.M. EG and G Mound Applied Technologies, Miamisburg, OH (USA). [1989]. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-88DP43495. (CONF-8909113–6: 14. international pyrotechnics seminar, Jersey (UK), 18-22 Sep 1989). Order Number DE90001450. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Efforts to develop a titanium-boron pyrotechnic mixture for a heat source component are described. After a supposedly good blending procedure had been specified, a problem developed. Allegedly identical Ti/B blends exhibited differences in behavior. Extensive analytical characterization of the two blends and experiments designed to determine whether the differences could be related to moisture failed to solve the problem. However, mild grinding was found to activate Ti/B. A stereomicroscope examination revealed the existence of micro-inhomogeneities, which were different in the two blends. A laboratory experiment showed that differences in humidity at the time of blending explains how the two "identical" blends became different. The extent to which ball-milling removes the inhomogeneities is shown. Problems associated with the scale-up of ball-milling to production quantities are identified. The effectiveness of a twin-shell blender with a pin intensifier is described. Another problem that developed in the latter stages of the program was that the Ti/2B mole ratio blend was judged to be too hot for the component application. The success of tailoring blend output by addition of Al_2O_3 as a diluent is described. 5 refs., 2 figs.

53123 (MLM–3607(OP)) **Electrothermal response testing more than a quality assurance tool.** Munger, A.C. EG and G Mound Applied Technologies, Miamisburg, OH (USA). [1989]. 11p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-88DP43495. (CONF-8909113–5: 14. international pyrotechnics seminar, Jersey (UK), 18-22 Sep 1989). Order Number DE90001449. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A simple engineering model of "hot wire" behavior has been constructed based on the electrothermal parameters that can be obtained by the application of that nondestructive test technique. The model uses the data taken before the pyrotechnic charge is loaded on the wire as background data. The data is taken as a loaded component is modified by the before loading data. The ETR data is combined with the auto-ignition temperature for the pyrotechnic and the restive heating capacity for the bridgewire to predict an approximate ignition time for the device. A modification of the procedure can be used to predict the no-fire level of the device. A reasonable estimate of the spread in ignition threshold currents at constant current can be obtained by applying the data spread in the ETR gamma values to the no-fire estimate. One of the major benefits of the model is that the temperature of the pyrotechnic mix and the bridgewire can be calculated and presented graphically. This visualization brings together many of the known facts about the electrically ignited system. The relationship between hot and cold firings, high and low current inputs, and the thermal properties of the ignition interface are easily seen.

53124 (MLM–3608(OP)) **Critical temperature analysis for a hemispherical charge of a binary explosive.** Pickard, J.M. EG and G Mound Applied Technologies, Miamisburg, OH (USA). 1989. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-88DP43495. (CONF-8909169–3: 18. North American Thermal Analysis Society conference, San Diego, CA (USA), 24-27 Sep 1989). Order Number DE90001447. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The adiabatic induction period for a hemispherical charge of a binary explosive (13.9 wt % pentaerythritol tetranitrate (PETN) and 86.1 wt % plastic bonded explosive (PBX9407)) enclosed in an aluminum/ceramic housing was measured by conventional cook-off tests over the temperature range of 150 to 250°C. Simulated adiabatic induction time curves for an intimate mixture of PETN and PBX9407 were recorded with accelerating rate calorimetry (ARC). Apparent heat-transfer coefficients approximating conductive and convective modes of heat-transfer were calculated from cooling curves recorded for the charge housing loaded with mock explosive powder (diphenyl silane diol) and water, respectively. Predicted critical temperatures based on models utilizing Semenov and Frank-Kamenetskii boundary constraints were in good agreement with experimental results determined from the cook-off test. 6 refs., 5 figs., 3 tabs.

53125 (UCRL–99559) **Propagation of detonation waves from an impact region.** Lee, R.S.; Tao, W.C.; Crouch, L.D. Lawrence Livermore National Lab., CA (USA). 1989. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890811–40: 9. international symposium on detonation, Portland, OR (USA), 28 Aug - 1 sep 1989). Order Number DE90001184. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We have developed an experimental system for studying the propagation of a detonation wave away from a region that is initiated by the impact of a thin flyer plate. We have studied the propagation of detonation waves away from this region in pressed pellets of TATB and in RX-26-AF, a TATB/HMX formulation. The system permits measurements at elevated, ambient and low temperatures. We measured the distance-time trajectory and arrival time of the detonation front at the downstream face of the explosive pellets for pellets with thicknesses of 1-16 mm over the temperature range -80°C to +80°C. 9 refs., 10 figs.

4502 Nuclear

Refer also to citation(s) 51742, 51907, 52195, 52955, 53114

53126 (AD-A–208525/6/XAB) **Modeling regional seismic waves from underground nuclear explosion. Report for 17 March 1987-30 March 88.** Clayton, R.W.; Harkrider, D.G.; Helmberger, D.V. California Inst. of Tech., Pasadena, CA (USA). Seismological Lab. 9 May 1988. 92p. (SCIENTIFIC–1). Available from NTIS, PC A05/MF A01.

Two main topics are presented: the effects of ocean continent transition zones on L - g waves; and modeling regional Love waves with 2-D velocity structures. Hybrid regional and teleseismic SH mode sum seismograms are produced after propagation through a regional transition zone or other heterogeneity that exists as part of a longer, mostly plane-layered, path. In particular the effects of ocean continent transition regions of geometry for propagation along a partially oceanic path is at most a factor of four. Extending the oceanic path length changes this factor to at most 6. This is inadequate to explain the observed attenuation of Lg. Thus, additional effects, must be considered to provide a complete explanation of the attenuation of Lg. Long period seismograms recorded at Pasadena of earthquakes occurring along a profile to Imperial Valley are studied in terms of source phenomena versus path effects. Some of the events have known source parameters, determined by teleseismic or near-field studies, and are used as master events in a forward modeling exercise to derive the Green's functions that describe the propagation effects along the profile. Both timing and waveforms of records are matched by synthetics calculated from 2-dimensional velocity models. The best 2-dimensional section begins at Imperial Valley with a thin crust containing the basin structure and thickens towards Pasadena.

53127 (AD-A–209074/4/XAB) **US and Soviet strategic command and control: implications for a protracted nuclear war. Master's thesis.** Lippold, K.S. Naval Postgraduate School, Monterey, CA (USA). Mar 1989. 163p. Available from NTIS, PC A08/MF A01.

This thesis addresses the relative ability of the command and control systems of the United States and Soviet Union to support a protracted nuclear war. It covers the development and structure of the command and control organizations used to support the respective National Command Authorities. In discussing these organizations, the various systems supporting the command and control apparatus are also covered. This includes the threat warning and attack assessment equipment used to determine strategic and tactical warning and the communications equipment used to alert forces of increased readiness and the conduct of nuclear strikes if required. The technical factors associated with the performance of C3 in a nuclear environment will also be covered. The result is a net assessment of the two command and control systems that highlights the strengths and weaknesses inherent in each. Recommendations to help enhance the United States' position regarding this national security issue are also developed.

53128 (AD-A–209254/2/XAB) **Lg-wave propagation in heterogeneous media. Final report, 15 February 1988-14 February 1989.** Kennett, B.L. Australian National Univ., Canberra (Australia). Research School of Earth Sciences. 6 Apr 1989. 69p. Available from NTIS, PC A04/MF A01.

The Lg wave is of importance for nuclear-discrimination problems because it is commonly the largest phase on a seismic record at regional ranges. It is therefore likely to be detected even for quite small events. The energy comprising Lg is dominantly guided in the crustal waveguide which is known to be a region with very considerable horizontal variability in properties. The effect of heterogeneity on Lg and other regional phases was assessed by the development of a new method for the description of seismic-wave-propagation processes in laterally varying media. This scheme is based on propagation operators that allow for the major processes of interconversion between seismic wave types. This approach is used to generate descriptions of the propagation processes contributing to the main regional seismic phases Pn, Pg, Sn and Lg. These representations are then used to examine the theoretical basis for the discriminants between earthquakes and underground nuclear explosions based on the relative amplitudes of P and S waves. The ratio of Sn to Pn amplitude looks promising as a high-frequency discriminant. However, the ratio of Lg to Pn amplitudes is not as useful because of the complex nature of the propagation characteristics of Lg.

53129 (AD-A–209335/9/XAB) **Emerging high-frequency (HF) and related radio-communications concepts for enduring C(3)I roles in a nuclear war environment: Critical issues in nuclear weapons effects on propagation. Topical report, 5 January-1 June 1980.** Gabbard, C.B.; LeLevier, R.E. R and D Associates, Marina del Rey, CA (USA). 1 Jun 1980. 148p. Available from NTIS, PC A07/MF A01.

This document summarizes the nuclear weapons effects on propagation issues that must be considered in judging the overall nuclear effects vulnerability of selected strategic C3 concepts envisioned to provide enduring C3I support in nuclear war. This document focuses on the propagation effects in bands ranging from MF to UHF, with emphasis on HF skywave propagation during and after periods of nuclear conflict. The report is composed of short contributions from selected experts in the field of nuclear propagation effects (from RDA, SRI and Rand) and is intended to provide a guide for those asked to make system procurement decisions, in a complex and specialized but critical area.

53130 (AD-A–209336/7/XAB) **Nuclear-survivable C(3) system design. Technical report.** Addicott, L.; Cicolani, A.; Maloney, J. R and D Associates, Marina del Rey, CA (USA). 1 Feb 1982. 112p. (RDA-TR–113400-006). Available from NTIS, PC A06/MF A01.

This volume of the final report 'Nuclear Survivable C3 System Design' presents the preliminary results and briefing of the study to configure a survivable and enduring C3 system to support Long Range TNF. The guidelines required implementation of existing or developmental systems. The results integrate C3 elements selected from strategic system developments and modifications of current LRTNF C3 facilities into a preliminary system description for the near term.

53131 (ORNL/FEMA–89/2) **Electromagnetic Pulse (EMP) survey of the Louisiana State Emergency Operating Center, Baton Rouge, Louisiana.** Crutcher, R.I.; Buchanan, M.E.; Jones, R.W. Oak Ridge National Lab., TN (USA). Aug 1989. 101p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE90002112. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The purpose of this report is to develop an engineering design package to protect the federal Emergency Management Agency (FEMA) National Radio System (FNARS) facilities from the effects of high-altitude electromagnetic pulses (HEMP). This report refers to the Louisiana State Emergency Operating Center (EOC) in Baton Rouge, Louisiana. This report addresses electromagnetic pulse (EMP) effects only, and disregards any condition in which radiation effects may be a factor. It has been established that, except for the source region of a surface burst, EMP effects of high-altitude bursts are more severe than comparable detonations in either air or surface regions. Any system hardened to withstand the more extreme EMP environment will survive the less severe conditions. The threatening environment will therefore be limited to HEMP situations. 76 figs., 2 tabs.

53132 (UCRL–52000-89-7/8) **Energy and Technology Review, July–August 1989.** Poggio, A.J.; Burnham, A.K. (eds.). Lawrence Livermore National Lab., CA (USA). 1989. 110p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90000994. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The Lawrence Livermore National Laboratory, operated by the University of California for the United States Department of Energy, was established in 1952 to do research on nuclear weapons and magnetic fusion energy. Since then, we have added other major programs, including laser fusion and laser isotope separation, biomedical and environmental sciences, and applied energy technology. Our most recent major project, for the Strategic Defense Initiative Organization, is research on the free-electron laser. These programs, in turn, require research in basic scientific disciplines, including chemistry and materials science, computer science and technology, engineering, and physics. The Laboratory also carries out a variety of projects for other federal agencies. Energy and Technology Review is published monthly to report on unclassified work in all our programs.

53133 **A model for atomic bomb dose computations.** Hall, C.J. *Transactions of the American Nuclear Society (USA),* 56: 299-301 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The purpose of this work was to benchmark a new mathematical model for atomic fission bomb dose computations. This model can be used by health physicists, radiological engineers, and nuclear safety personnel. The SAFETYSHIELD general-purpose dose and shielding computer code contains a built-in model for a fission-type nuclear blast. This model was used to compute the gamma-bremsstrahlung emission rates generated by a 20-kiloton (kt) fission nuclear bomb at various distances from the atomic blast. The resulting dose rates were also computed These computed dose and emission rates were compared with values obtained from published sources. The comparison included the dose rates generated for various shielding arrangements and fission product decay times.

4503 Explosion Detection

Refer also to citation(s) 52872

53134 (UCRL–100795) **In-situ equivalent CO_2 estimates using a neutron-induced gamma-ray spectroscopy logging system.** Hearst, J.R.; Conaway, J.G.; Mathews, M.A.; Barber, J.W. Lawrence Livermore National Lab., CA (USA). Sep 1989. 28p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8909163–5: 5. symposium on containment of underground nuclear detonations, Santa Barbara, CA (USA), 19-21 Sep 1989). Order Number DE90001024. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We are trying to adapt a commercial neutron-induced gamma-ray spectroscopy log to estimate carbonate content in emplacement (2-4-m diameter) boreholes at the Nevada Test Site. Such a log would test a much larger (and therefore presumably more representative) sample than the few grams currently used in sample analysis and would be continuous rather than discrete. We have performed large-scale laboratory experiments using test boxes filled with mixtures of silica sand and crushed limestone. The test boxes are 5 m long, and the material is screeded into a cylindrical arc of 1.2-m radius to simulate our borehole environment. These tests showed that the log is sensitive not only to carbonate content but also to water content of the formation as well as the gap between the logging sonde and the wall of the borehole. Consequently, we modified the sonde to measure the sonde-wall gap and developed procedures for correcting the measured carbonate content for water content and gap. When we used these procedures in the laboratory, with a moving sonde and a rough (3- 8-cm variations) surface on the test mixture, we obtained an accuracy of better than 0.02 equivalent dry weight fraction CO_2 (the amount of CO_2 that would be generated if all the carbonate were converted to CO_2). 14 refs., 15 figs.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

Refer also to citation(s) 53178

53135 (DOE/ER/60304–H1) **Global lake-level variations from 18,000 to 0 years ago: A paleoclimate analysis.** Street-Perrott, F.A.; Marchand, D.S.; Roberts, N.; Harrison, S.P. Oxford Univ. (UK). Geography School. Sep 1989. 213p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-85ER60304. Order Number DE90000998. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

Fluctuations in the water levels of lakes are an important source of information about past climates, and can be used to validate paleoclimatic simulations made with atmospheric general-circulation models. The Oxford Lake-Level Data bank contains information about variations in the water levels of approximately 360 lake basins during the last 30,000 years. This data set was compiled as part of COHMAP (the Climates of the Holocene Mapping Project). In this report, regional and global maps of lake status (coded as high, intermediate or low) at 18, 15, 12, 9, 6, 3, and 0 thousand years. Before Present are presented and compared with numerical simulations for the same time slices carried out with NCAR Community Climate Model. Although agreement between the data and the model is generally excellent, significant discrepancies occur. These may reflect the effects of changes in boundary conditions that were not included in the experiments, for example increases glacial-age aerosol loadings, as well as the inability of the model to portray some of the complexities of the climate system such as oceanic circulation and orographic effects. 781 refs., 51 figs.

53136 (PB–89-207369/XAB) **National Climate Program Five-Year Plan, 1989-1993.** National Climate Program Office, Rockville, MD (USA). Dec 1988. 52p. Available from NTIS, PC A04/MF A01.

Also available from Supt. of Docs. See also PB–89-118608.

The Five-Year Plan for the National Climate Program fulfills the need as expressed by Congress, to create a framework for the nation to cope with, understand, and predict climate. The Plan presents broad outlines for program needs over the next few years and enumerates specific goals to be incorporated into plans of participating agencies. Scientists and administrators agree, that the tasks ahead are far beyond what can be accomplished in a short time. The Plan recognizes resource and time limitations and attempts to set realistic priorities. The recommended program will produce early and useful results for the most-immediate needs while building the scientific knowledge base required in the longer term. The Plan covers the fiscal years 1989 to 1993. It sets the goals and objectives for the coming half-decade and summarizes the present status of the U.S. National Climate Program. The most notable accomplishments over the past few years are briefly mentioned. More-detailed information can be found in the National Climate Program's Annual Reports to Congress and the President.

5002 Chemicals Monitoring and Transport

Refer also to citation(s) 51680, 51723, 51726, 51860, 52037, 52150, 52152, 52154, 52155, 52456, 52457, 52491, 52492, 52501, 52505, 52836, 52964, 52965, 53209, 53255, 53546, 53551, 53552, 53553, 53554

53137 (AD-A–209426/6/XAB) **Field evaluation of direct-reading continuous ethylene oxide monitors. Final report.** Hossain, M.A.; Carpenter, D.R. Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA). May 1989. 11p. (OEHL–89-036EH0100EEF). Available from NTIS, PC A03/MF A01.

The Wilford Hall USAF Medical Center Central Processing Section (WHMC/SGLP) uses ethylene oxide (EtO) as a primary sterilizing agent. Because of their concern about the health effects of EtO, SGLP has searched for a continuous-monitoring EtO system. In their search, they found two units (AMSCO's Envirogard III and Baseline Industries, Inc.'s Model 5500 Gas Analyzer). The objective of this evaluation was to conduct a field study to compare the performances of the two direct-reading continuous EtO monitors against the Occupational Safety and Health Administration's (OSHA) acceptable charcoal-tube sampling method. In addition, the 3M EtO passive monitor sampling method was compared with the charcoal-tube method and direct-reading instrumental method as well. Neither the Baseline Industries, Inc. nor the AMSCO continuous monitors corresponded to OSHA acceptable charcoal tube method of air sampling. Both instruments reported EtO concentrations much higher than those detected by the charcoal tubes. There is no way of knowing which method, the direct-reading continuous monitor or the charcoal tube/passive monitor, is more correct. However, the OSHA standard for EtO is based on measuring EtO by the charcoal tube method.

53138 (BNL–43240) **Long-term worldwide environmental effects caused by acid rain from fossil fuels.** Manowitz, B.; Lipfert, F.W. Brookhaven National Lab., Upton, NY (USA). 1989. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890841–2: International workshop on safety of nuclear installations of the next generation and beyond, Chicago, IL (USA), 28-31 Aug 1989). Order Number DE90001534. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Acid rain is regarded as an environmental problem of growing importance in many parts of the world; it is one of the adverse effects of air pollution. This paper presents data on emissions of air pollutants from combustion of fossil fuels and discusses atmospheric processes that act on these emissions, various effects of air pollution and acid deposition, and some of the aspects of regulation of these pollutants. Evidence of worldwide concern is shown by contrasting the perceived adverse effects of air pollution with ambient levels and the status of regulation. 25 refs., 3 figs., 3 tabs.

53139 (CONF-891113–2) **Minimization of chromium-contaminated wastewater at a plating facility in the Eastern United States.** Walker, J.F. Jr.; Wilson, J.H.; Brown, C.H. Jr. Oak Ridge National Lab., TN (USA). [1989]. 20p. Sponsored by U.S. Department of Defense; U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From American Institute of Chemical Engineers annual meeting; San Francisco, CA (USA); 5-10 Nov 1989. Order Number DE90001062. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Because construction of a new plating facility is currently planned, a complete renovation of the existing plating facility is not economically feasible. As a result, the program sponsor, the Naval Energy and Environment Support Activity (NEESA), was given the task of demonstrating the use of innovative wastewater treatment technologies that will minimize the hazardous wastes generated at the facility and maintain compliance with the local discharge limits until the new facility is constructed. This paper will discuss (1) the plating facility modifications which resulted in an 85% reduction of the quantity of chromium contamination exiting the plating facility, (2) the results of the RO pilot-scale tests, and (3) start-up of the full-scale RO/evaporator system at the plating facility. 1 ref., 8 figs., 3 tabs.

53140 (CONF-8803229–, pp. 4-9) **Global change and the changing atmosphere.** Clark, W.C. (Harvard Univ., Cambridge, MA (USA)). National Research Council, Washington, DC (USA). Board on Atmospheric Sciences and Climate; National Research Council, Washington, DC (USA). Committee on Global Change. 1989. From Joint symposium on ozone depletion, greenhouse gases and climate change; Washington, DC (USA); 23 Mar 1988. In *Ozone depletion, greenhouse gases, and climate change. Proceedings.* Order Number DE89016111. Available from OSTI; National Academy Press, 2101 Constitution Ave., NW, Washington, DC 20418 $20.00.

The historical aspects of the scientific observations of global change are briefly discussed along with the administration of global change research and response programs.

53141 (CONF-8803229–, pp. 10-18) **Stratospheric ozone depletion: Global processes.** Albritton, D.L. National Research Council, Washington, DC (USA). Board on Atmospheric Sciences and Climate; National Research Council, Washington, DC (USA). Committee on Global Change. 1989. From Joint symposium on ozone depletion, greenhouse gases and climate change; Washington, DC (USA); 23 Mar 1988. In *Ozone depletion, greenhouse gases, and climate change. Proceedings.* Order Number

DE89016111. Available from OSTI; National Academy Press, 2101 Constitution Ave., NW, Washington, DC 20418 $20.00.

This paper summarizes the ozone science that lead to the "Montreal Protocol on Substances that Deplete the Ozone Layer." It touches on three points: (1) what ozone theory said to those crafting the Montreal Protocol; (2) what ozone observations told that policy group; and (3) how policy responded to those scientific statements.

53142 (CONF-8803229–, pp. 19-32) **Stratospheric ozone depletion: Antarctic processes.** Watson, R.T. National Research Council, Washington, DC (USA). Board on Atmospheric Sciences and Climate; National Research Council, Washington, DC (USA). Committee on Global Change. 1989. From Joint symposium on ozone depletion, greenhouse gases and climate change; Washington, DC (USA); 23 Mar 1988. In *Ozone depletion, greenhouse gases, and climate change. Proceedings.* Order Number DE89016111. Available from OSTI; National Academy Press, 2101 Constitution Ave., NW, Washington, DC 20418 $20.00.

This paper describes the current understanding of the Antarctic ozone hole phenomenon. Two questions are addressed: (1) What are the observations of ozone that define how large and "deep" the antarctic hole is?; and (2) What is our present understanding of cause and effect?

53143 (CONF-8803229–, pp. 33-47) **The role of halocarbons in stratospheric ozone depletion.** Rowland, F.S. (Univ. of California, Irvine (USA)). National Research Council, Washington, DC (USA). Board on Atmospheric Sciences and Climate; National Research Council, Washington, DC (USA). Committee on Global Change. 1989. From Joint symposium on ozone depletion, greenhouse gases and climate change; Washington, DC (USA); 23 Mar 1988. In *Ozone depletion, greenhouse gases, and climate change. Proceedings.* Order Number DE89016111. Available from OSTI; National Academy Press, 2101 Constitution Ave., NW, Washington, DC 20418 $20.00.

This paper discusses two topics: (1) halocarbons in the atmosphere; and (2) the measurement of ozone. Beginning in 1978, the author's research group made gas chromatographic measurements of trichlorofluoromethane with air samples from many locations in both hemispheres that were judged to be sufficiently remote from local emission sources. All of the data showed the level of chlorofluorocarbons (CFCs) rising rapidly during the 1980s, with the Southern Hemisphere lagging behind the Northern Hemisphere by about 10 percent despite the fact that 95% of the CFCs are released in the Northern Hemisphere. Ozone measurements have been made since 1931 in Arosa, Switzerland and in Bismark, North Dakota, measurements began in 1963. It has been found that ozone in the Northern Hemisphere decreases during the winter, but this decrease diminishes gradually at lower latitudes, rather than abruptly as in the southern Hemisphere, suggesting that atmospheric circulation is causing dilution in the Northern Hemisphere. The studies of the author's research group showed that, when the winter data are analyzed separately, a significant loss of ozone has occurred during the winter months.

53144 (CONF-8803229–, pp. 48-56) **Heterogeneous chemical processes in ozone depletion.** Molina, M.J. (National Aeronautics and Space Administration, Pasadena, CA (USA)). National Research Council, Washington, DC (USA). Board on Atmospheric Sciences and Climate; National Research Council, Washington, DC (USA). Committee on Global Change. 1989. From Joint symposium on ozone depletion, greenhouse gases and climate change; Washington, DC (USA); 23 Mar 1988. In *Ozone depletion, greenhouse gases, and climate change. Proceedings.* Order Number DE89016111. Available from OSTI; National Academy Press, 2101 Constitution Ave., NW, Washington, DC 20418 $20.00.

This discussion focuses on the reaction between hydrogen chloride and chlorine nitrate. The reaction does not occur only in the gas phase, but instead requires a condensed phase in order to proceed. Free chlorine atoms are believed to be the principal agents for destroying ozone. Hydrogen chloride and chlorine nitrate species are not directly reactive with ozone, but they act as sinks, or reservoirs, of chlorine in the atmosphere.

53145 (CONF-8803229–, pp. 56-66) **Free radicals in the earth's atmosphere: Measurement and interpretation.** Anderson, J.G. (Harvard Univ., Cambridge, MA (USA)). National Research Council, Washington, DC (USA). Board on Atmospheric Sciences and Climate; National Research Council, Washington, DC (USA). Committee on Global Change. 1989. From Joint symposium on ozone depletion, greenhouse gases and climate change; Washington, DC (USA); 23 Mar 1988. In *Ozone depletion, greenhouse gases, and climate change. Proceedings.* Order Number DE89016111. Available from OSTI; National Academy Press, 2101 Constitution Ave., NW, Washington, DC 20418 $20.00.

The mechanistic aspects of the ozone depletion problems are discussed. The author reviews some recent results that deal with the fundamental chemical structure of the stratosphere and homogeneous gas-phase catalysis. A second area discussed is Antarctic ozone depletion. The author also reports some results obtained in early 1988 regarding aircraft flights in the Northern Hemisphere that reached 61° N latitude.

53146 (CONF-8803229–, pp. 66-78) **Theoretical projections of stratospheric change due to increasing greenhouse gases and changing ozone concentrations.** Mahlman, J.D. National Research Council, Washington, DC (USA). Board on Atmospheric Sciences and Climate; National Research Council, Washington, DC (USA). Committee on Global Change. 1989. From Joint symposium on ozone depletion, greenhouse gases and climate change; Washington, DC (USA); 23 Mar 1988. In *Ozone depletion, greenhouse gases, and climate change. Proceedings.* Order Number DE89016111. Available from OSTI; National Academy Press, 2101 Constitution Ave., NW, Washington, DC 20418 $20.00.

The author reviews the ensemble of gases present in the stratosphere and their effects and then discusses what the NASA-WMO Ozone Trends Panel has learned from recent ozone trends in the stratosphere. The final, and largest part of the paper deals with future trends and projections of stratospheric change to increasing greenhouse gases and changing ozone concentrations.

53147 (CONF-8803229–, pp. 79-84) **Historical trends in atmospheric methane concentration and the temperature sensitivity of methane outgassing from boreal and polar regions.** Harriss, R.C. National Research Council, Washington, DC (USA). Board on Atmospheric Sciences and Climate; National Research Council, Washington, DC (USA). Committee on Global Change. 1989. From Joint symposium on ozone depletion, greenhouse gases and climate change; Washington, DC (USA); 23 Mar 1988. In *Ozone depletion, greenhouse gases, and climate change. Proceedings.* Order Number DE89016111. Available from OSTI; National Academy Press, 2101 Constitution Ave., NW, Washington, DC 20418 $20.00.

During the past decade, it has become clear that current changes in the earth's atmospheric composition are global in scale. Studies on atmospheric CH_4 will provide critical information on how the earth's biosphere and atmosphere will respond to the global warming that is forecast by climate models to occur in the next few decades. Such research will also provide the necessary scientific data to make sound regulatory decisions if policy makers decide to arrest or reverse the growth of sources of CH_4 produced by human activities.

53148 (CONF-8803229–, pp. 85-97) **Global temperature trends.** Trenberth, K.E. National Research Council, Washington, DC (USA). Board on Atmospheric Sciences and Climate; National Research Council, Washington, DC (USA). Committee on Global Change. 1989. From Joint symposium on ozone depletion, greenhouse gases and climate change; Washington, DC (USA); 23 Mar 1988. In *Ozone depletion, greenhouse gases, and climate change. Proceedings.* Order Number DE89016111. Available from OSTI; National Academy Press, 2101 Constitution Ave., NW, Washington, DC 20418 $20.00.

This paper focuses mainly on stratospheric temperature trends and covers some aspects of tropospheric temperatures. The last section discusses what is happening in the antarctic region. The principal issue considered is the consistency of ozone and other trace gas changes, and of the expected temperature changes resulting from such trace gas changes, with actual temperature changes.

53149 (CONF-8803229–, pp. 98-102) **Use of numerical models to project greenhouse gas-induced warming in polar**

regions (the conceptual basis developed over the last twenty years). Dickinson, R.E. National Research Council, Washington, DC (USA). Board on Atmospheric Sciences and Climate; National Research Council, Washington, DC (USA). Committee on Global Change. 1989. From Joint symposium on ozone depletion, greenhouse gases and climate change; Washington, DC (USA); 23 Mar 1988. In *Ozone depletion, greenhouse gases, and climate change. Proceedings.* Order Number DE89016111. Available from OSTI; National Academy Press, 2101 Constitution Ave., NW, Washington, DC 20418 $20.00.

The development of numerical models that will accurately predict climatic change caused by greenhouse gases has been a long-term, continuing research effort. The focus of this paper is the concepts involved and the results of that effort, especially as they apply to the polar regions.

53150 (DOE/EH–0102) **A compendium of options for government policy to encourage private sector responses to potential climate change: Executive summary.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (USA). Office of Environmental Analysis. Oct 1989. 115p. Sponsored by U.S. DOE Environment Health & Safety. Order Number DE90000951. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

Report to the Congress of the United States.

The structure of this executive summary invites a word of explanation for the reader. Conventionally, such a summary presents the principal findings of a study and summarizes the research design and procedures by which the results were obtained. This report, however, is designed as a reference document consisting of a compendium of generic policy instruments and specific policy options that are available to the US Government in the event that it decides to encourage significant private sector to prevent, mitigate, or adapt to climate change. As such, most of the body of this report consists of summaries of existing knowledge about and experience with these policy instruments, and identifies opportunities and constraints for their application. The study did not attempt to establish a bottom-line recommendation, therefore, one cannot be presented here. 11 tabs.

53151 (DOE/ER/60304–5) **Evaluation of climatic models: Comparison of simulated and observed patterns for past climates: Progress report, February 1, 1989–January 31, 1990.** Prell, W.L.; Web, T. III; Kutzbach, J.E. Brown Univ., Providence, RI (USA). Dept. of Geological Sciences; Wisconsin Univ., Madison, WI (USA). Center for Climatic Research. Oct 1989. 19p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-85ER60304. Order Number DE90001228. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Comparison of the GCM results with paleoclimatic data can yield critical tests of the models that are being used in carbon dioxide research. In particular, the comparison of model results with paleoclimatic data can illustrate the sensitivity of the model's response to variations in the seasonal radiation budget as well as to changes in other boundary conditions. These comparisons also provide the opportunity to check the sensitivity of the climatic response of critical components of the climate system such as sea-ice and soil moisture. During the past several years, we have used paleoclimatic data to test NCAR CCM (National Center for Atmospheric Research, Community Climate Model) after changing its boundary conditions to those appropriate for simulating past climates. We have assembled regional and global paleoclimatic data sets of pollen, lake level, and marine plankton data and calibrated many of the data in climatic terms. We have also developed methods that permit direct quantitative comparisons between the data and model results. Our comparisons have shown both some of the strengths and weaknesses of the model. 64 refs.

53152 (DOE/ER/69017–1) **Climate system research studies of global and regional instrumental data: Progress report for period December 1, 1988–November 30, 1989.** Bradley, R.S.; Diaz, H.F.; Jones, P.D. Massachusetts Univ., Amherst, MA (USA). Sep 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-89ER69017. Order Number DE90001205. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Further improvements in the DOE temperature and precipitation station data sets have been made and a new merged set of temperature data (1851–1989) is in preparation. The world-wide precipitation data set is also being improved, and a study of precipitation variations over different continental regions was published. A draft of a joint US/USSR paper on temperature and precipitation changes over the last 150 years was also prepared. There were 1545 and 656 precipitation stations used in analyzing northern and southern hemisphere precipitation, respectively. All these stations had at least 35 years of data in the period 1921–60. The number of station records available declines dramatically for the 1970s and 1980s, particularly over Africa and Asia. Considerable amounts of additional precipitation data have been located for Africa, Australia and Asia, principally for the post-1970 period, and these are currently being digitized.

53153 (EPRI-EN–6526) **Paleoecological Investigation of Recent Lake Acidification (PIRLA), 1983–1985.** Charles, D.F.; Whitehead, D.R. (eds.). Electric Power Research Inst., Palo Alto, CA (USA); Indiana Univ. Foundation, Bloomington, IN (USA). c Oct 1989. 263p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The "Paleoecological Investigation of Recent Lake Acidification" (PIRLA) project, funded by the Electric Power Research Institute, is a broadly interdisciplinary paleoecological study of recent lake acidification. Approximately ten lakes are being studied in each of four low alkalinity regions in North America that are currently receiving acid deposition. The areas are the Adirondack Mountains (NY), northern New England, northern Great Lakes Region, and northern Florida. Sediment cores are being analyzed for diatom and chrysophyte remains to reconstruct acidification histories, including magnitude, rate, and timing of pH and alkalinity changes. Cores are dated using lead-210 and pollen and charcoal. Other sediment analyses include metals, sulfur, soot, and polycyclic aromatic hydrocarbons (PAH). These provide information on lake acidification histories, and the relative roles of natural acidification processes, watershed disturbance, and atmospheric deposition of strong acids. This interim report contains seven papers representing the status of project research as of March 1985. Results support the hypothesis that diatom and chrysophyte sediment stratigraphies can be used to determine the extent of past variations in the pH levels of lakes.

53154 (HESS–8801, pp. 43-49) **Global warming by carbon dioxide and other gases.** Tanaka, Masayuki (Tohoku Univ., Sendai (Japan)). Hydrogen Energy System Society, Tokyo (Japan). 17 Nov 1988. (In Japanese). (CONF-8811261–: 9. conference on researches on hydrogen energy system, Tokyo (Japan), 17 Nov 1988). In *Proceedings of the 9. conference on researches on hydrogen energy system.* Order Number DE89772186. Available from NTIS (US Sales Only), PC A04/MF A01.

The global warming by Co_2, etc. was investigated. The concentration of atmospheric CO_2 increased at a rate of 1.3 ppM/year in 1979-1985. As the consumption of carbon in fossil fuels is 5,100 million tons/year, 54 % of released CO_2 remained in the atmosphere. With CO_2 released from living organism taken into consideration, the proportion of remaining CO_2 in the atmosphere is 40-45 %, indicating 56-61 % of released CO_2 must be absorbed in the ocean. This has raised a problem since theories in the past do not support such a high rate of absorption by the ocean and quantitative analysis is required on sources of release and absorption. Significant uncertainty is left in the estimation of CO_2 concentration. Temperature rise of 3 +-1.5^{0}C in average and 2.5 time of this value for polar regions are estimated to be caused by doubled concentration of CO_2. Rapid increase in heat insulating from gas is another problem. Improved accuracy of observation and climatic models is essential for prediction of effects of CO_2 and other gases on climate. 6 references, 6 figures.

53155 (IEIE–8802, pp. 4) **Production of NOX and processing.** Ito, Yasuo (Musashi Institute of Technology, Tokyo (Japan)); Sakai, Takao; Ehara, Yoshiyasu. Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on*

lectures for joint conference of societies related to electricity and information. Available from NTIS (US Sales Only), PC A02/MF A01.

NO_2 is picked out as a representative of NOX for the experimental study on the production and decomposition characteristics by aerial discharge. NO_2 showed distinctive cyclic characteristics in association with other NO_2 series substances under somewhat low pressures. The result of the experimental study on the characteristics of decomposition by NO_2 mixed dilute gas is reported. HNO_3, O_3, NO_2, and NO repeat periodical generation and disappearance by the discharge in the air of approximately 250 Torr. The period is the factor of humidity, temperature, atmospheric pressure, and discharge current. NO_2 is decomposed by discharge, and the decomposed volume is nearly proportinal to the discharge current. The decomposition rate is the highest in Ar dilution, and the decomposition ratio is the best in the case of N_2 and Ar. O_2 dilution did not produce good NO_2 decomposition characteristics. 7 references, 7 figures.

53156 (ORNL/FTR–3378) **[The effects at ozone on CO_2 assimilation by bean plants]: Foreign trip report, September 2–15, 1989.** Norby, R.J. Oak Ridge National Lab., TN (USA). 25 Sep 1989. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90001094. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler participated in ongoing laboratory experiments on the effects of ozone on Co_2 assimilation by bean plants, providing advice on experimental procedures, assistance with data analysis, and access to current literature. He presented a seminar in which the importance of research on elevated CO_2 and global climate change was emphasized because these are areas of major emphasis at Oak Ridge National Laboratory in which international collaboration would be especially beneficial. The most promising area for future collaboration was identified as the integration of experimental research with a tree growth model developed at Tartu University.

53157 (PB–89-190219/XAB) **Suitability of diffusion and wind-field techniques for an emergency-response dispersion model. Technical memo.** Eckman, R.M.; Dobosy, R.J. National Oceanic and Atmospheric Administration, Silver Spring, MD (USA). Air Resources Lab. Apr 1989. 38p. (NOAA-TM-ERL-ARL–171). Available from NTIS, PC A03/MF A01.

Most atmospheric dispersion models have two separate components: a diffusion component that simulates the dilution of a contaminant by turbulence, and a wind-field component that transport the contaminant away from the source. Many modeling techniques have been developed for each of these components. This report examines the suitability of these modeling techniques for a near-field emergency response model that must simulate the dispersion of a hazardous contaminant out to several kilometers from a source. For an emergency response model that must provide real-time dispersion estimates (a Class A model), a puff model is the most appropriate diffusion technique, and simple interpolation is the most appropriate wind-field technique. For more-complex models that are used for emergency planning and post-accident assessments (Class B models), a puff model is still suitable, but the wind-field technique should be able to remove spurious velocity divergence and channel the wind flow in complex terrain.

53158 (PB–89-196323/XAB) **Handbook for decision on industrial atmospheric-contaminant exposure levels. Final Field Handbook.** Systems Control, Inc., Palo Alto, CA (USA). Jun 1974. 106p. (SCI–5103-2). Available from NTIS, PC A06/MF A01.

Portions of this document are not fully legible.

A Final Field Handbook developed as a procedural tool to determine if employee exposure to an atmospheric-contaminant level exceeds present federal standards is presented. First definitions of terms and notations are given, and then a step-by-step procedure is presented which implements the techniques developed. Specific examples of procedures are appended to illustrate and demonstrate the use of the handbook for computing the decision variables, determining and estimating a trend, decision-making, and obtaining estimates of contaminant level. Also illustrated are the use of a computational worksheet, the use of standardized graph paper and trend transparencies, and the use of the decision chart and estimation nomographs. A description of the mathematical formulation of trends and explanations of the trend-labeling method are presented. The relationship between the arithmetic average and the average value of a long-normally distributed variable is discussed, and blank copies of worksheets and standardized graphs are provided.

53159 (PB–89-197214/XAB) **Onset of electrical breakdown in dust layers. 2. Effective dielectric constant and local field enhancement.** Young, R.P.; DuBard, J.L.; Sparks, L.E. Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab. 1988. 8p. (EPA–600/J-88/289). Available from NTIS, PC A02/MF A01.

Part 1 of the work has shown that electrical breakdown in dust layers obeys Paschen's Law, but occurs at applied field values which appear too small to initiate the breakdown. In this paper the authors show how an effective dielectric constant characterizing the dust layer can be determined from AC dielectric measurements and the theory of Debye. When combined with an expression for the enhanced local electric field in the void spaces between particles in the layer, field strengths which are large enough to initiate electrical breakdown in the layer are predicted at relatively low values of applied field. The effect of temperature and dust-layer thickness on the onset of electrical breakdown within the dust layer can also be explained by the dependence of the effective dielectric constant on these parameters.

53160 (PB–89-197743/XAB) **Onset of electrical breakdown in dust layers. 1. Microsparking described by paschen's law.** Young, R.P.; DuBard, J.L.; Sparks, L.E. Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab. 1988. 10p. (EPA–600/J-88/253). Available from NTIS, PC A02/MF A01.

Pub. in Jnl. of the Air Pollution Control Association, Vol. 38, No. 11, 1412-1418(Nov 1988).

This paper describes a study of the onset of electrical breakdown in dust layers, for hand-deposited dust layers in a parallel-plate geometry. It was found that the breakdown was an ordinary electron-avalanche process originating in voids within the dust layer and obeying Paschen's Law. The size of voids where breakdown occurs was in the range of 10-20 micrometers for the layers used. The distribution of particle sizes in a sample influences its breakdown through changes in the average void dimension where breakdown takes place. Water vapor in the test environment, which affects the electrical conduction mechanism prior to breakdown, lowered the average electric field required to initiate breakdown. Moderate compaction of the sample had little or no effect on its breakdown behavior.

53161 (PB–89-197883/XAB) **Investigation of two features of continuously released heavy gas plumes. Report for September 1986-December 1988.** Hall, D.J.; Waters, R.A. Warren Spring Lab., Stevenage (UK). 1989. 57p. (LR–707(PA)M). Available from NTIS, PC EE04/MF E04.

Color illustrations reproduced in black and white.

This report describes an investigation, using a wind tunnel model, of two specific aspects of the dispersion of continuously released, ground based, heavy gas plumes. These were, firstly, to examine the range of releases which might be described as 'slightly heavy' gases, in which the plume passes from the neutrally buoyant state to that of a clearly heavier-than-air plume with a high degree of stability and strongly density driven flow components. Secondly, the effect of source size on plume dispersion was examined for two distinct plume types, one of relatively small scale with respect to the source and with a modest degree of stability, and one of relatively large scale with respect to the source and with a high degree of stability. A significant feature of the results is the sensitivity of the plume to the detailed form of the source.

53162 (PB–89-197909/XAB) **Assessment of particle and heavy-metal concentrations in the atmosphere around the Port Talbot works of the British Steel Corporation. Report for February-May 1987.** Davis, B.J. Warren Spring Lab., Stevenage (UK). 1988. 34p. (LR–636(PA)M). Available from NTIS, PC EE05/MF E05.

This report describes a survey carried out around the British Steel Corporation's Port Talbot works. Port Talbot works is one of five large integrated steel works operated by the British Steel Corporation within the United Kingdom. The objective of such surveys is to

assess the possible contribution of emissions, with emphasis on low-level fugitive emissions, i.e., those emanating from below stack height, to their concentrations in the ambient atmosphere using the Directional M-type Sampler.

53163 (PB–89-197941/XAB) **Assessment of particle and lead concentrations in the atmosphere around Associated Octel Ltd. at Ellesmere Port. Report for August 1986-January 1987.** Davis, B.J. Warren Spring Lab., Stevenage (UK). 1988. 39p. (LR–677(PA)M). Available from NTIS, PC EE05/MF E05.

Concentrations of lead in the ambient atmosphere have been measured during a twenty-two week period at four sites in the vicinity of Ellesmere Port. The measurements were made using a directional M-type sampler, which provided two weekly samples. One was taken when the wind was blowing from the direction of the works, the second during all other wind directions. For fifteen weeks at the SHOP, Admin and Cabot sites, and for the whole of the survey period at the Poole Centre, the sampling filters were modified to measure both inorganic and organic lead. The proximity of the SHOP and Cabot sites to the works taken in conjunction with the relevant enhancement factors suggests that the works was contributing low-level (in terms of height) fugitive emissions of organic lead to the ambient atmosphere.

53164 (PB–89-197958/XAB) **Ozone monitoring in the UK (United Kingdom): A review of 1978/8. Data from monitoring sites operated by Warren Spring Laboratory.** Bower, J.S.; Broughton, G.F.; Dando, M.T. Warren Spring Lab., Stevenage (UK). 1988. 63p. (LR–678(AP)M). Available from NTIS, PC EE06/MF E06.

Color illustrations reproduced in black and white.

A new national air-quality monitoring network has been established for the Department of the Environment. Its purpose is to determine rural baseline concentrations of ozone and other pollutants throughout the United Kingdom. The report describes the background to the establishment of the network, together with its present structure and instrumentation. A series of data analyses are presented and discussed, with the intention of providing a broad and preliminary overview of ozone observations at WSL-operated monitoring sites throughout the first full year of network operation. Average and peak levels of ozone during 1987/8 are quantified, seasonal and diurnal variations are determined, and high pollution periods are examined.

53165 (PB–89-197966/XAB) **Acid rain in the United Kingdom: Spatial distributions and seasonal variations in 1986. Report for January 1986-August 1988.** Campbell, G.W.; Cocksedge, J.L.; Coster, S.M.; Dennis, A.L.; Devenish, M. Warren Spring Lab., Stevenage (UK). 1988. 72p. (LR–691(AP)M). Available from NTIS, PC EE06/MF E06.

Color illustrations reproduced in black and white.

Maps of the concentration and deposition of acidity and other ions over all of the United Kingdom during 1986 have been drawn. The results are compared with the limited data available for earlier periods. Seasonal variations are presented and box plots used to summarize information on frequency distributions. Analyses of daily measurements have provided estimates of 'background' non-marine sulfate concentration in rain and the contributions of United Kingdom and European sources to non-marine sulfate deposition at a site in East Anglia.

53166 (PB–89-197990/XAB) **UK (United Kingdom) emissions of air pollutants, 1970-1986.** Eggleston, H.S. Warren Spring Lab., Stevenage (UK). 1988. 30p. (LR–659(AP)M). Available from NTIS, PC EE05/MF E05.

Emissions of CO, NOx, SO, and VOC into the atmosphere from the UK are presented for the years 1970-1986. Tables giving more detail for the period 1976-1986 are included. This is the first in a projected annual series of publications.

53167 (PB–89-200828/XAB) **EPA (Environmental Protection Agency) Regional Oxidant Model (ROM2.0): Evaluation on 1980 NEROS data bases. Report for January 1987-April 1989.** Schere, K.L.; Wayland, R.A. Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Research and Exposure Assessment Lab. Jun 1989. 370p. (EPA–600/3-89/057). Available from NTIS, PC A16/MF A01.

The second-generation U.S. EPA Regional Oxidant Model (ROM2.0) has been evaluated for the northeastern United States using the 1980 NEROS data bases. The theoretical basis of the model and its structure and organization are described. The data bases available from the summer 1980 period include routine air-quality and meteorological monitoring data in addition to data from several extensive field-measurement projects conducted during the summer of 1980 in the northeastern U.S. on regional and urban scales. Also, a complete emissions inventory, composed of anthropogenic and biogenic components, was assembled for the 1980 base year for use in air-quality modeling. The ROM2.0 evaluation was conducted using quasi-deterministic and diagnostic techniques.

53168 (PB–89-203889/XAB) **Summary of data on individual organic contaminants in sediments collected during 1984, 1985, 1986, and 1987. Progress report.** National Ocean Service, Rockville, MD (USA). Office of Oceanography and Marine Assessment. Apr 1989. 149p. (NOAA/TM/NOS/OMA–47). Available from NTIS, PC A07/MF A01.

Since 1984, the National Oceanic and Atmospheric Administration's National Status and Trends Program has analyzed samples of surface sediment collected at about 200 coastal and estuarine sites throughout the United States. The chemical contaminants measured are chlorinated pesticides, polychlorinated biphenyls, polyaromatic hydrocarbons, and 12 trace elements. The report, containing the data for the individual organic chemicals, is a supplement to the previously issued report that contained all the metal and aggregated organic data.

53169 (PB–89-204697/XAB) **Research on noise and environmental issues. Transportation Research Record.** Weiss, M.; Creasey, F.T.; Agent, K.R.; Slutsky, S.; Bertoni, H.L. National Research Council, Washington, DC (USA). Transportation Research Board. 1988. 102p. (TRB/TRR–1176). Available from NTIS, PC A06/MF A01.

Library of Congress catalog card No. 89-9364.

The 12 papers in the report deal with the following areas: Summary of highway noise barrier construction in the United States; Effectiveness of traffic noise barrier on I-74 in Campbell County, Kentucky; Analysis and programs for assessment of absorptive and tilted parallel barriers; Tilted Parallel Barrier Program: application and verification; Construction noise: I-78 through the Watchung Reservation; Highway traffic noise prediction for microcomputers: modeling of Ontario simplified program; Noise barriers and the community involvement process; Overview of NJDOT's mitigation program; Acoustical insulation design for existing schools and residences near San Francisco International Airport; Development and verification of the California line source dispersion model; Dispersion characteristics of flows in asymmetric street canyons and sensitivity to block shape; Corrections to hot- and cold-start vehicle fractions for microscale air-quality modeling.

53170 (PB–89-204721/XAB) **Development and implementation of an up-to-date photochemical mechanism for use in airshed modeling. Appendices A-C. Summary report, 2 May 1986-2 May 1988 (Final).** Carter, W.P.L.; Atkinson, R. California Univ., Riverside, CA (USA). Statewide Air Pollution Research Center. Oct 1988. 713p. Available from NTIS, PC A99/MF E04.

A two-year program was carried out to develop an updated gas-phase photochemical mechanism for airshed models and computer software for its implementation. Current knowledge of the gas-phase chemistry of emitted organics was comprehensively reviewed and evaluated. The gas-phase mechanism previously developed by the authors was updated and extended to include representations of the kinetics and representations of over 100 types of emitted organic compounds. Several condensed mechanisms for use in airshed models were developed, allowing model users to choose the appropriate level of chemical detail for their application. Software was developed for the automatic preparation of chemical mechanisms for use in airshed models. Emissions-processing procedures and software were developed to allow model users to derive the kinetic and mechanistic parameters for the species in the model which corresponds to those for the emitted species which they represent. Assignments of detailed model species were made for over 350 categories of emitted organics, accounting for essentially all of

the mass of identified organic emissions into California air basins in the 1983 emissions inventory data base.

53171 (PB–89-206643/XAB) **Wind direction effects on dispersion from sources downwind of steep hills.** Castro, I.P.; Snyder, W.H.; Lawson, R.E. Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab. Jan 1988. 12p. (EPA–600/J-88/335). Available from NTIS, PC A03/MF A01.

Pub. in Atomospheric Environment, Vol. 22, No. 10, 2229-2238(1988).

A previous experimental study of the nature of dispersion from point sources down-wind of three-dimensional hills of various cross-wind aspect-ratio (spanwise breadth/height) was extended to the case when the approaching wind is not normal to the spanwise axis of the hill. Surface concentration patterns resulting from sources placed at various heights were examined, with attention limited to cases which led to the greatest concentration for the normal wind direction (theta=0). Sufficient data have been obtained to determine the terrain amplification factor (i.e., the ratio of the maximum ground-level concentration in the presence of the hill to that in its absence) for various wind directions, hills and source heights, and also to find how the ground-level concentration at the position of its maximum value for theta=0 varies with wind direction. It is demonstrated that in some circumstances the amplification factor (A) for a particular source position actually increases with small changes in wind direction. In general, however, there is a monotonic decrease in A as theta deviates from zero, which is most rapid for hills of small aspect ratio. In the case of wider hills, it is possible for the amplification factor to be reduced below unity for large theta.

53172 (PB–89-206676/XAB) **Video images of smoke dispersion in the near wake of a model building. Part 1. Temporal and spatial scales of vortex shedding.** Huber, A.H. Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Research and Exposure Assessment Lab. 1988. 38p. (EPA–600/J-88/332). Available from NTIS, PC A03/MF A01.

Pub. in Jnl. of Wind Engineering and Industrial Aerodynamics, Vol. 31, 189-224(1988).

In a wind-tunnel study, recorded video images of smoke dispersion in the wake of a rectangular-shaped building were analyzed. A continuous source of smoke was emitted at floor level, midway along the leeward side of the building. Smoke was observed to build up within a region adjacent to the building. Then the smoke was periodically swept away by vortices shed from the leeward building sides and roof. The applicability of analyzing time series of smoke scattered light for selected quantized video picture elements was favorably demonstrated. Temporal and spatial scales of vortex-shedding of smoke puffs near the center of the wake were quantified through the calculation of spectral densities and autocorrelations. The dominant frequencies (cycles/second) near the center of the wake flow were found to be 0.1-0.3 times the ratio of the velocity to the building height. Estimated integral length scales near the center of the wake flow were found to be 1-2 times the building height.

53173 (PB–89-206718/XAB) **Evidence for cloud venting of mixed-layer ozone and aerosols.** Ching, J.K.S.; Shipley, S.T.; Browell, E.V. Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab. 1988. 20p. (EPA–600/J-88/327). Available from NTIS, PC A03/MF A01.

Pub. in Atmospheric Environment, Vol. 22, No. 2, 225-242(1988).

Observations are presented which substantiate the hypothesis that significant vertical exchange of ozone and aerosol pollutants occurs between the mixed layer and the free troposphere during cumulus cloud convective activity. Flight experiments conducted in July 1981, utilized the airborne Ultra-Violet Differential Absorption Lidar system developed by NASA. This system provides simultaneous range-resolved ozone concentration and aerosol-backscatter profiles with high spatial resolution. Data were obtained during the afternoon along East to West and South to North intersecting transects over North Carolina in the presence of active, non-precipitating cumulus clouds.

53174 (PB–89-206726/XAB) **Modeling ozone concentrations: Urban- and regional-scale models are needed to develop emission-control policies that reduce ozone levels.** Schere, K.L. Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab. May 1988. 10p. (EPA–600/J-88/326). Available from NTIS, PC A02/MF A01.

Pub. in Environmental Science and Technology, Vol. 22, 488-495(May 1988).

Regional-scale air-quality models are needed for coordinated planning of emission-control strategies to reduce the ozone pollutant burden. Urban-scale models by themselves cannot provide the link from one source area to the next. In the paper the structural components of the more rigorous grid-type regional ozone models are described along with some of the issues that must yet be resolved to achieve credible regional scale simulations. Chief among these issues are the questions of the magnitude and photochemical effects of regional-scale biogenic organic emissions, the mass transfer from the lower to upper boundary layer by cloud fluxes, the lack of determinism in regional-scale wind fields, and perhaps most critically, how to properly describe the subgrid scale chemical and physical processes within the enormous volume of a regional gridcell. The major components and recent applications of five representative regional-scale air-quality models are presented.

53175 (PB–89-206742/XAB) **Performance of a Gaussian model for centerline concentrations in the wake of buildings.** Huber, A.H. Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab. 1988. 14p. (EPA–600/J-88/324). Available from NTIS, PC A03/MF A01.

Pub. in Atmospheric Environment, Vol. 22, No. 6, 1039-1050(1988).

The inherent variability of 10- to 60-min average ground-level plume centerline concentrations in the wake of buildings and inherent limitations on the performance of a Gaussian plume model are presented. Point comparisons between observed and model-predicted concentrations were evaluated for three sets of field measurements. The presentation is based on a quantitative evaluation of the same model that was qualitatively evaluated in another presentation. The same method prescribed for estimating enhanced dispersion in the wake of buildings and its incorporation into the Gaussian plume equation is used here. A sample of performance measures is judged to provide an adequate basis for determining the strengths and weaknesses of the model. For groups with reduced measures of mean error, the variability among errors was reduced to values between 50 and 100% of the mean concentration, which appears here to represent the inherent limitation of a simple Gaussian plume model.

53176 (PB–89-206809/XAB) **Summary of selected data on chemical contaminants in sediments collected during 1984, 1985, 1986, and 1987. Technical memo.** National Ocean Service, Rockville, MD (USA). Office of Oceanography and Marine Assessment. Nov 1988. 105p. (NOAA/TM/NOS/OMA–44). Available from NTIS, PC A06/MF A01.

Since 1984, the National Oceanic and Atmospheric Administration's (NOAA) National Status and Trends (NS&T) Program has analyzed samples of surface sediment collected at about 200 coastal and estuarine sites throughout the United States. The chemical contaminants measured are chlorinated pesticides, polychlorinated biphenyls (PCSs), polyaromatic hydrocarbons (PAHs), and 12 trace elements. Sediment characteristics such as grain size, which affect contaminant concentrations, have also been quantified. With few exceptions, the higher levels of contamination have been found among the 175 sites where the sediment is muddy rather than sandy. Most of the highest concentrations for any particular contaminant have been at the 20 sites near Boston, New York, San Diego, Los Angeles, or Seattle. Despite being sandy, sediments at two Long Island Sound sites showed high levels of PAHs. Except for some sites near the Florida cities of Jacksonville, Tampa, Panama City, and Ft. Walton Beach, levels of contamination at sites in the Gulf of Mexico and in the southeastern United States were relatively low.

53177 (PB–89-207021/XAB) **Statistical comparison of results of two indoor-air pilot studies. Final report, 10 December 1987-29 February 1988.** Mack, G.A.; Stockrahm, J.W.; Chuang, J.C. Battelle Columbus Div., OH (USA). Jun 1989. 146p. Available from NTIS, PC A07/MF A01.

See also PB–87-129524.

The objective of the study was to compare the results between two previous indoor-air PAH monitoring studies conducted by EPA in 1984 and 1987. Both of the previous studies were pilot studies involving ambient and indoor air monitoring at a small number of residences in Columbus, Ohio. The objectives of these studies were to characterize the ranges of selected PAH and nitrogen heterocyclic compounds in the indoor air and to evaluate contributions of various indoor combustion sources to the indoor PAH concentration levels. The current study compared the results between the 1984 and 1987 studies and, where the results were consistent, the data from the two studies were combined to produce more-precise statistical estimates of concentration-level ranges and estimates of the contributions of different indoor combustion sources to indoor PAH levels.

53178 (PB–89-207476/XAB) **Stratospheric ozone depletion.** Environmental Protection Agency, Washington, DC (USA). Information Management and Services Div. May 1989. 72p. (EPA/IMSD–89/001). Available from NTIS, PC A04/MF A01.

This bibliography focuses solely on stratospheric ozone depletion. Global climate change, a related issue, is not within its scope. The first section contains an overview of stratospheric ozone issues. The second section, entitled 'science', discusses atmospheric chemistry and dynamics, specifically trace gas emissions and ozone/UVB levels. The third section contains citations relating to risk assessment for humans and other organisms. Section IV includes information on domestic and international public policy. The fifth section outlines research on substitutes and alternatives for ozone-depletion substances. Worldwide participants in the Montreal Protocol are listed in the Appendix.

53179 (PB–89-208375/XAB) **Micrometeorological investigation of surface exchange of trace gases: A case study. Technical memo.** Hicks, B.B.; Matt, D.R.; McMillen, R.T. National Oceanic and Atmospheric Administration, Silver Spring, MD (USA). Air Resources Lab. Mar 1989. 78p. (NOAA-TM-ERL-ARL–172). Available from NTIS, PC A05/MF A01.

Data obtained in an intensive field study of the dry deposition of sulfur dioxide, ozone, and nitrogen dioxide, conducted in 1985 in central Pennsylvania, are used to illustrate the factors that must be considered to assure that high-quality results are derived. In particular, the quality of the site must be such that flux measurements made above the surface are representative of surface values. For this purpose, tests involving momentum transfer and the surface energy budget are especially useful. In addition, conditions must not be changing rapidly, and the statistical uncertainty associated with flux measurement must be low. For the set of data presented here, conservative quality-assurance guidelines are used to reject potentially erroneous flux data.

53180 (PB–89-208649/XAB) **Estimation of contemporary carbon in fine-particle aerosols from the 1987 SCAQS (Southern California Air Quality Study) program. Final report.** Global Geochemistry Corp., Canoga Park, CA (USA). Apr 1989. 64p. Available from NTIS, PC A04/MF A01.

See also PB–86-223427.

During the Southern California Air Quality Study of 1987, the aerosol content of biogenic carbon was investigated. Twenty-four-hour fine-particle aerosol samples were collected at four sites, and the carbon in the samples was analyzed for content of the radioactive isotope ^{14}C (which decays with a half-life of 5730 years and is not present in fossil fuels). The percentage of modern carbon varied in 36 samples between 17.3 and 97.6%. These high contents of modern carbon indicate the possibility that 20% of the fine-particle atmospheric aerosol (as organic matter and elemental carbon) in the southern California urban area is due to non-fossil fuel emissions.

53181 (PB–89-208961/XAB) **Study of the NO_3 radical decomposition reaction and the N_2O_5 in equilibrium with NO_3 + NO_2 equilibrium constant. Final report.** Davidson, J.A.; Cantrell, C.A.; Shetter, R.E.; Calvert, J.G. National Center for Atmospheric Research, Boulder, CO (USA). Atmospheric Chemistry Div. 1989. 97p. Available from NTIS, PC A05/MF A01.

A determination was made of several important spectroscopic and thermodynamic properties of three oxides of nitrogen which are important in atmospheric chemistry, NO_2, NO_3 and N_2O_5. In the first phase, a redetermination was made of the absorption cross sections of NO_2 (visible and ultraviolet regions), NO_3 (visible region), and N_2O_5 (infrared regions), the effects of temperature, concentration of gas and instrument resolution on the cross sections were determined. The new cross section data were used in the second phase of the study in the redetermination of the equilibrium constant for N_2O_5 dissociation: $N_2O_5 > NO_3 + NO_2$. The first studies designed to measure the apparent first order decay of the NO_3 radical shed new light on the several conflicting results related to these parameters, and allow a clearer choice of reliable data for use in the simulation of the atmospheric chemistry of the oxides of nitrogen and in the prediction of reasonable control strategies for these oxides.

53182 (PB–89-209670/XAB) **Time-resolved size distributions of sub-4 micrometers particle sulfur and nitrate. Final report.** Allen, D.T. California Univ., Los Angeles, CA (USA). Dept. of Chemical Engineering. 1989. 83p. Available from NTIS, PC A05/MF A01.

Size-segregated atmospheric aerosol was collected at Claremont, California during the 1987 Southern California Air Quality Study (SCAQS) using low-pressure impactors. The single-orifice impactors separated the aerosol into eight size fractions, ranging in aerodynamic diameter from 0.05 micrometer to greater than 4 micrometers. The size fractions were analyzed for sulfur using a flash volatilization-flame photometric method, for nitrate using ion chromatography, and for nitrate, carbonyl, and aliphatic carbon using infrared spectroscopy. These measurements of aerosol composition were coordinated with experiments conducted by other CRC-APRAC contractors. The other contractors measured ambient visibility and the changes in particle size associated with changes in humidity. The data collected in these experiments will be a rigorous test of current visibility models and will help to guide future work in atmospheric visibility modeling.

53183 (PB–89-214431/XAB) **National dioxin study: Analytical procedures and quality assurance plan for the analysis of 2,3,7,8-TCDD in Tier 3-7 samples of the US Environmental Protection Agency National Dioxin Strategy.** Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab. May 1986. 41p. (EPA–600/3-85/019). Available from NTIS, PC A03/MF A01.

See also PB–87-213963.

Analytical methodology used by EMSL-RTP, ECL-BSL, and ERL-D in the analysis of samples for the study of Tiers 3-7 in the U.S. EPA National Dioxin Strategy is provided. The methods are based on low- and high-resolution mass spectrometry using stable-isotope-labeled internal standards. The methods were peer reviewed by the Quality Assurance Committee for the National Dioxin Strategy, as revised in November 1984. The methods are to serve only as a guideline for these analyses and may be modified as required to successfully meet target detection limits.

53184 (PB–89-217897/XAB) **Air-toxics technical assistance for the state of Alaska. Final report.** Dickson, R.J.; Peoples, S.H.; Oliver, W.R. Radian Corp., Sacramento, CA (USA). 30 Mar 1987. 261p. (DCN–87-203-024-81-02). Available from NTIS, PC A12/MF A01.

An air toxics emission inventory was developed for the state of Alaska. The inventory focuses on both point (i.e., specifically identified facilities) and area sources. The area source inventory does not identify facilities, but instead consists of aggregated emission totals for a geographic area. Activity data were obtained for the time periods ranging from 1979 to 1986. Included in the report are exact sources of information and the time periods for which they were derived, and a summary of point and area source emissions by source type. Also included are tables of data by air toxic compound and a detailed list of the point source emissions by source. Threshold limit values were used to rank the emission sources and the results are tabulated.

53185 (PB–89-220586/XAB) **Laboratory and field evaluation of a methodology for determination of hydrogen chloride emissions from municipal and hazardous-waste incinerators.** Steinsberger, S.C.; Margeson, J.H. Entropy Environmentalists, Inc., Research Triangle Park, NC (USA). Apr 1989. 83p. Available from NTIS, PC A05/MF A01.

Laboratory and field studies were performed to develop and evaluate a sampling and analytical technique for measuring hydrogen chloride (HCl) from stationary sources. Studies were conducted in three phases (1) literature seach and development of a candidate sampling and analysis protocol, (2) laboratory evaluation and refinement of the protocol, and (3) field evaluation. A modified Method 6 sampling train was selected for sample collection due to its ease of operation, availability, and cost. An acidified water-absorbing solution was identified for collecting HCl in the impingers. The acidified water solution was selected to minimize the potential for diatomic chlorine (Cl_2) to interfere with the HCl determination. Ion chromatography was selected as the most suitable technique for the analysis of HCl. The laboratory phase evaluated the HCl collection efficiency of the sampling protocol and the distribution of Cl_2 in the sampling train. A preliminary field test was included in the laboratory phase to indicate any further protocol modifications. A ruggedness test was designed to evaluate the effect of six variables that may be encountered when employing the sampling protocol. A field evaluation was conducted to determine the precision and estimate the accuracy of the sampling and analytical protocol. The candidate method was also employed to determine the bias and precision of two HCl continuous emission-monitoring systems.

53186 (PB–89-865869/XAB) **Indoor air pollution: Health effects. January 1970-July 1989 (Citations from the COMPENDEX data base). Report for January 1970-July 1989.** National Technical Information Service, Springfield, VA (USA). Aug 1989. 39p. Available from NTISPC N01/MF N01.

This bibliography contains citations concerning health effects associated with indoor pollutants. Pollutants discussed include carbon dioxide, nitrogen oxides, particulates, formaldehyde, carbon monoxide, paints, pesticides, solvents, smoke, sealants, soils, adhesives, aerosols, dusts, cleaners, and moisture. Health effects ranging from simple discomfort and tight or sick building syndrome to maladies such as Legionnaires' disease and cancer are discussed. Test methods for detecting indoor pollutants are briefly cited. (Contains 61 citations fully indexed and including a title list.)

53187 (PNL-SA–16496-1) **Global energy and the greenhouse issue.** Scott, M.J.; Edmonds, J.A.; Kellogg, M.A.; Schultz, R.W. Pacific Northwest Lab., Richland, WA (USA). Sep 1989. 20p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-76RL01830. (CONF-890901–1: 14. world energy conference, Montreal (Canada), 17-22 Sep 1989). Order Number DE90001394. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Global energy production and use results in the release of Co_2 and other gases to the atmosphere which affect the atmosphere's radiative character. The accumulation of CO_2 and other radiatively important (RIGs) is thought to result in higher mean global surface temperatures and other climatic changes, whose character would vary regionally around the globe. Of critical importance to determining the timing and magnitude of global climate change is an understanding of long term global energy systems. 19 refs., 3 tabs.

53188 (UBA-FB–87-092/1.1.1) **Measurement and assessment of the heavy metal emissions from selected installations and suggested measures for their reduction. Partial report on measurements of the heavy metal and trace element emissions of a 45 t/h steam boiler fueled with heavy oil.** Luetzke, K.; Sobottka, H. Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen (Germany, F.R.). Zentralabteilung Emissionsmessungen; Umweltbundesamt, Berlin (Germany, F.R.). Oct 1987. 132p. (In German). Contract UFOPLAN-Nr. 10403185. Available from Copy held by UB/TIB Hannover.

Over a period of one year the emission of dust, selected heavy metals and trace elements and, randomly sampled, also of SO_2, SO_3, NO and CO from a 45 t/h steam boiler burning heavy oil were measured in two periods. Furthermore, the particle size distribution in flue dust and the dew point of the acid were determined. On the average 1.3 respectively 1.8 t fuel oil/h were burned. The medium dust load of the waste gas amounted to 8 respectively 9.7 mg/m^3. After the two measurement periods the boiler was cleaned. Samples of the boiler ash, the fuel and the flue dust were analyzed for the presence of Cd, Cr, Hg, Ni, Pb, V and Zn in order to determine specific emissions rates for the individual elements with Cd, Hg, Ni, Pb and V also measured in the gas phase, and to allow balancing. Cr, Pb and Zn showed comparatively good balances while about 50% of the Ni and V burned with the fuel was found again in the emission. Together Ni and V made up for about 97% of the total emission of the elements examined here. The average values determined by the analyses were: 50% value of the particle size distributions in flue dust: 0.8-1.1 μm; dew point of the acid: 148^{0}C; waste gas concentrations of $SO_2/SO_3/(NO+NO_2)$ calculated as NO_2/CO: 2078/165/<10 mg/m^3. The specified concentrations (mg/m^3) refer to dry waste gas of standard temperature and pressure with 3% oxygen. (orig.) With 13 refs., 49 tabs., 25 figs.

53189 (UBA-FB–87-092/1.1.2) **Measurement and assessment of the heavy metal emissions from selected installations and suggested measures for their reduction. Partial report on measurements of the heavy metal and trace element emissions of a 25 t/h steam boiler fueled with heavy oil.** Luetzke, K.; Sobottka, H. Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen (Germany, F.R.). Zentralabteilung Emissionsmessungen; Umweltbundesamt, Berlin (Germany, F.R.). Oct 1987. 41p. (In German). Contract UFOPLAN-Nr. 10403185. Available from Copy held by UB/TIB Hannover.

For 5 days of measurement the emissions of dust, selected heavy metals and trace elements (As, Cd, Cr, Hg, Ni, Pb, Se, Tl, V and Zn) from a 25 t/h steam boiler burning heavy oil were determined. As, Cd, Hg, Se and Tl were also measured in the gas phase. For the waste gas dust loadings between 33 and 46 mg/m^3, i.e. a mean value of 38 mg/m^3 referred to dry waste gas with 3% by volume of oxygen were measured. Among the substances examined vanadium with a mean value of 9.9 mg/m^3 and nickel with a mean value of 1.8 mg/m^3 made up the largest fraction. About 90% of the ash brought in together with the boiler fuel was emitted and about 10% precipitated inside the boiler. The results of the balances for Cr, Ni, Pb, V and Zn partly differed from these values. (orig.) With 17 tabs., 3 figs.

53190 (UBA-FB–87-092/1.2.1) **Measurement and assessment of the heavy metal emissions from selected installations and suggested measures for their reduction. Partial report on measurements of the heavy metal and trace element emissions of a stationary fluidized-bed system.** Luetzke, K.; Sobottka, H. Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen (Germany, F.R.). Zentralabteilung Emissionsmessungen; Umweltbundesamt, Berlin (Germany, F.R.). Oct 1987. 100p. (In German). Contract UFOPLAN-Nr. 10403185. Available from Copy held by UB/TIB Hannover.

For a stationary fluidized-bed firing plant for various fuels with a steam boiler downstream and a combination of cyclone separator and fabric filter for waste gas dedusting upstream, the mass flows of dust, selected heavy metals and trace elements (As, Be, Cd, Cr, Cu, Hg, Mn, Ni, Pb, Se, Te, Tl, V and Zn) were determined (As, Cd, Hg, Se and Tl also for the gas phase) which are emitted together with the waste gases when firing coal middlings and high-grade coal. Furthermore the particle size distribution in pure gas dust was determined by impacter measurements. The specific emission factors for the individual elements were calculated and the corresponding balances for the system 'fluidized-bed firing plant' were established. For the heavy metals and trace elements examined in this context distinctively higher concentrations in the pure gas compared to the source material, especially for coal of high value, and parallel concentrations in the range of small size fractions (up to 85% in the range <1,4 μm) were detected. The average dust emission from high-grade coal combustion amounted to 0.13 kg/h and by the firing of middlings to 0.39 kg/h with a 50% value of the particle size distribution in pure gas dust of 4 μm respectively 3 μm. The highest emission factors referred to 1 TJ thermal output were determined for the firing of coal of high value (7.1 g of Zn, 6.5 g of Pb, 6.1 g of V, 5.1 g of Ni and 4.5 g of Mn) and for the firing of middlings (35.2 g of Zn, 8.8 g of Mn, 6.2 g of V, 4.4 g of Cu and 4.0 g of Pb). (orig.) With 8 refs., 28 tabs., 21 figs.

53191 (UBA-FB–87-092/1.2.2) **Measurement and assessment of the heavy metal emissions from selected installations and suggested measures for their reduction. Partial report on measurements of selected gaseous constituents of the off-gases of a stationary fluidized-bed combustion system.** Luetzke, K.; Sobottka, H. Rheinisch-Westfaelischer Technischer

Ueberwachungs-Verein e.V., Essen (Germany, F.R.). Zentralabteilung Emissionsmessungen; Umweltbundesamt, Berlin (Germany, F.R.). Oct 1987. 32p. (In German). Contract UFOPLAN-Nr. 10403185. Available from Copy held by UB/TIB Hannover.

In addition to the determination of trace elements and heavy metal content of waste gases from the burning of various fuels in a stationary fluidized-bed combustion plant with subsequent steam boiler and a combination of preceding cyclone separator and fabric filter for waste gas dedusting, measurements for the determination of the mass contents of sulphur dioxide (SO_2), nitrogen oxides (NO, NO_2) and gaseous inorganic chlorine and fluorine compounds (CL^-, F^-) in the waste gases from the burning of coal tailings and coal of high value were carried out under otherwise equal conditions. Furthermore mass flows of sulphur, nitrogen, chlorine and fluorine brought in by the fuel were determined. The examinations were carried out to allow statements on the emission behaviour and retention capacity of the plant with regard to the substances mentioned above. For sulphur, chlorine and fluorine retention degrees of 68%/39%/about 100% were measured for coal retailings and 79%/61%/94% for high-grade coal. The concentration of SO_2 in pure gas amounted to 610 mg/m^3 respectively 430 mg/m^3 and the concentration of nitrogen oxide (calculated for NO_2) amounted to 688 mg/m^3 respectively 609 mg/m^3; all values refer to dry waste gas at standard temperature and pressure with an oxygen content of 7%. (orig.) With 6 refs., 10 tabs., 2 figs.

53192 (UBA-FB–87-092/1.2.3) **Measurement and assessment of the heavy metal emissions from selected installations and suggested measures for their reduction. Partial report on measurements of the heavy metal and trace element emissions of a circulating fluidized-bed system.** Luetzke, K.; Scheuer, A.; Sobottka, H. Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen (Germany, F.R.). Zentralabteilung Emissionsmessungen; Umweltbundesamt, Berlin (Germany, F.R.). Oct 1987. 112p. (In German). Contract UFOPLAN-Nr. 10403185. Available from Copy held by UB/TIB Hannover.

For a circulating fluidized-bed combustion plant for coal of high inerts, equipped with a secondary steam boiler and a heat exchanger for the recovery of process heat, upstream mill drying of the coal and waste gas dedusting by fabric filters, the mass flows of dust, selected heavy metals and trace elements (As, Be, Cd, Cr, Hg, Mn, Ni, Pb, Se, Te, Tl and V) emitted with the waste gases were determined (for As, Cd, Hg, Se, Te and Tl also for the gas phase). Furthermore the particle size distribution in pure gas dust was determined by way of impacter measurements. The specific emission factors for the individual elements were determined and the corresponding balances for the system 'fluidized-bed firing plant' prepared. The comparison of the contents of trace elements showed for all elements with the exception of Tl increasing concentrations on its way from the source material to the pure gas. The medium dust emission amounted to a maximum 4.1 kg/h and a 50% value of the particle size distribution in pure gas dust of 3.0-3.5 μm. The highest emission factors determined were: 11.9 g of Hg, 3.3 g of Mn, 2.4 g of Pb, 2.2 g of V and 2.1 g of Te reffered to 1 TJ thermal output. (orig.) With 10 refs., 36 tabs., 12 figs.

53193 (UBA-FB–87-092/2.1) **Measurement and assessment of the heavy metal emissions from selected installations and suggested measures for their reduction. Partial report on measurements of the heavy metal and trace element emissions of a fluidized-bed furnace for sewage sludge combustion.** Luetzke, K.; Klee, W. Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen (Germany, F.R.). Zentralabteilung Emissionsmessungen; Umweltbundesamt, Berlin (Germany, F.R.). Oct 1987. 57p. (In German). Contract UFOPLAN-Nr. 10403185. Available from Copy held by UB/TIB Hannover.

For the ashing of 2.34-3.06 t/h of dry material in a combustion plant for sewage sludges (primary and anaerobic sludge) provided with a fluidized-bed furnace, an additional furnace for light fuel oil, and waste gas purification by multiple cyclone and venturi washer the mass flows of dust, selected heavy metals and trace elements (As, Be, Cd, Cr, Hg, Mn, Ni, Pb, Se, Te, Tl, V) as emitted with the waste gases were detemined (As, Cd, Hg, Pb, Se, Te and Tl also for the gas phase). In connection with other examinations it was proved that the elements As, Cd, Se, Te and Tl brought in together with the combustion material and the additional fuel are evidently higher concentrated in the pure gas dust than in the source material. With the exception of Hg and Se all elements brought in remained predominantly bonded in the bunker ash and only a maximum of 1% was set free. The Hg, however was almost completely emitted in the gas phase. The highest emission factors referred to 1 t of dry ash material were determined as: 3.97 g of Hg, 0.12 g of Cr, 0.09 g of Pb and 0.06 g of Mn. (orig.) With 5 refs., 15 tabs., 11 figs.

53194 (UBA-FB–87-092/2.2) **Measurement and assessment of the heavy metal emissions from selected installations and suggested measures for their reduction. Partial report on measurements of the heavy metal and trace element emissions of an industrial waste incineration plant.** Luetzke, K.; Klee, W. Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen (Germany, F.R.). Zentralabteilung Emissionsmessungen; Umweltbundesamt, Berlin (Germany, F.R.). Oct 1987. 57p. (In German). Contract UFOPLAN-Nr. 10403185. Available from Copy held by UB/TIB Hannover.

For the ashing of 1.29 t/h of solid, 1.52 t/h of mixed solid and liquid and 1.06 t/h of liquid waste in a combustion plant for non-dumpable solid and liquid industrial waste with waste heat boiler and waste gas dedusting by a single-stage horizontal-flow electrical precipator, the mass flows of dust, selected heavy metals and trace elements (As, Be, Cd, Cr, Cu, Hg, Mn, Ni, Pb, Se, Te, Tl, V and Zn) emitted together with the waste gases were measured (As, Cd, Hg, Se and Tl were also measured in the gas phase). In connection with other investigations the concentration of elements brought in with the combustion material and the additional fuel, in particular Cd and Se, could be detected. Specific emission factors were calculated for the indivdual elements. The mean dust emission from the ashing of solid, mixed solid and fluid and fluid waste amounted to 2.8 kg/h, 2.1 kg/h respectively 1.0 kg/h. The highest emission factors were determined in dependence of the type of ashed material and referred to 1 t of waste: 91-544 g of Pb, 132-488 g of Zn, 7.3-13.0 g of Cd, 3.9-13.0 g of Cr and 3.7-9.5 g of Cu. (orig.) With 1 ref., 13 tabs., 8 figs.

53195 (UBA-FB–87-092/2.3) **Measurement and assessment of the heavy metal emissions from selected installations and suggested measures for their reduction. Partial report on measurements of the heavy metal and trace element emissions of a household refuse incineration plant.** Luetzke, K.; Sobottka, H. Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen (Germany, F.R.). Zentralabteilung Emissionsmessungen; Umweltbundesamt, Berlin (Germany, F.R.). Oct 1987. 114p. (In German). Contract UFOPLAN-Nr. 10403185. Available from Copy held by UB/TIB Hannover.

In a combustion plant for municipal waste equipped with a cylinder grate furnace, an additional furnace for heavy fuel oil, an integrated 50 t/h steam boiler, a two-stage electrical horizontal-flow preciptator and an 'acid' venturi washer for waste gas purification, 15-20 t/h of domestic waste were ashed and the mass flows of dust, lead (Pb), cadmium (Cd) and mercury (Hg) carried with the waste gases were determined (Pb, Cd and Hg also for the gas phase) as they were present in the crude and the pure gas of the waste gas purification system and between the electrical precipitator and the venturi washer. Furthermore, the concentrations of SO_2, SO_3, $NO+NO_2$ (calculated as NO_2) and other gaseous inorganic chlorine (Cl^-) and fluorine (F^-) compounds were measured in the crude and the pure gas of the venturi washer. The specific separation efficiencies of the venturi washer referred to the material flow brought in with the waste gases were determined for NO + NO_2/Cl^-/F^- and Hg as: 16-19%/99.2-99.6%/80.3-95.5% behind the waste gas purification system as compared with the crude gas dust. The emission factors referred to 1 t of 'domestic waste' were calculated as: 5.1-22.6 g of Pb, 0.44-0.85 g of Cd and 0.32-0.52 g of Hg. (orig.) With 16 refs., 33 tabs., 11 figs.

53196 (UBA-FB–87-092/5) **Measurement and assessment of the heavy metal emissions from selected installations and suggested measures for their reduction. Partial report on an interlaboratory study on the precision of chemical methods of heavy metal and trace element analysis.** Luetzke, K.; Grossmann, W. Rheinisch-Westfaelischer Technischer

Ueberwachungs-Verein e.V., Essen (Germany, F.R.). Zentralabteilung Emissionsmessungen; Umweltbundesamt, Berlin (Germany, F.R.). Oct 1987. 79p. (In German). Contract UFOPLAN-Nr. 10403185. Available from Copy held by UB/TIB Hannover.

4 experienced laboratories took part in a cooperative test to confirm the chemical analyses of trace elements and heavy metals in material flows and emissions from various plants carried out in the course of the overall project and to obtain more distinctive data on the precision of such analyses. With the help of atomic absorption spectrometry 14 elements in 8 different substances and 2 filter residue samples were identified twice by placing dust samples, two at a time, on the quartz wad carrier respectively on quartz fibre table filters (dust mass only about 10 mg). As a final result of the evaluation of the interlaboratory test scattering values, the reproducibility r and comparability R were determined and discussed. For carrier-free samples the repeatabilities r of most elements and substances were <25% and the comparabilities between 25 and 50% (relative). The scattering values increase as expected for samples on filter mediums with own scattering power, especially for small sample quantities. (orig.) With 16 refs., 20 tabs.

53197 (UBA-FB–87-092/6) **Measurement and assessment of the heavy metal emissions from selected installations and suggested measures for their reduction. Partial report on a national statistics of plants emitting heavy metals and trace elements.** Luetzke, K.; Kier, B.; Bach, H.; Fricke, H.; Hauschild, H. Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen (Germany, F.R.). Zentralabteilung Emissionsmessungen; Umweltbundesamt, Berlin (Germany, F.R.). Oct 1987. 103p. (In German). Contract UFOPLAN-Nr. 10403185. Available from Copy held by UB/TIB Hannover.

In addition to the determination of trace elements and the heavy metal contents for selected industrial, commercial and communal plants a nation-wide registration of the number, size and mode of operation of plants of the type examined was carried out. The registration was based on the evaluation of general statistical material, business reports and technical publications as well as in a more detailed way by a well-aimed inquiry of plant operators the addresses of which were made available by professional associations or were gathered from technical publications or from lists of references. As for glass tanks a detailed registration was not possible due to insufficient information from the operators' side; boiler plants burning heavy oil was not available information as the necessary expenditure was expected to be too high. As far as communal refuse incineration plants are concerned an already existing detailed registration was evaluated. Among the plant operators addressed the operators of lignite-fuelled steam power plants respectively cylindrical rotary cement kilns proved to be particularly cooperative. All results obtained from the registration were presented in tables and explained to an adequate extent. (orig.) With 17 refs., 23 tabs.

53198 (UCRL–21214-Summ.) **Effectiveness of water spray mitigation systems for accidental releases of hydrogen fluoride: Summary report.** Lawrence Livermore National Lab., CA (USA); Industry Cooperative Hydrogen Fluoride Mitigation/Assessment Program (USA). Water Spray Subcommittee. Jun 1989. 36p. DOE Contract W-7405-ENG-48. Order Number DE90001181. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Several companies proposed the development of design information for water sprays as part of a mitigation system for facilities that either produce or consume HF. The program was composed of three separate components: water sprays, vapor barriers and ambient impact assessment. The objective of the water spray component was to investigate the effectiveness of water sprays in mitigating acid releases as a function of flow conditions, acid and spray properties and geometries factors. The water spray study consisted of HF and water laboratory studies and field studies. The HF laboratory studies were designed to conduct HF releases on a small scale. They had three objectives: to help define the test matrix for the larger scale field testing; to evaluate design criteria for a larger flow chamber; and to gain operating experience for the larger unit. These HF tests were performed at Mobil Central Research Laboratories at Princeton, during May and June of 1988. In addition, water laboratory studies were conducted to characterize the water spray curtain used in the field testing. This report summarizes the results from the HF laboratory studies and the field studies, which comprise the water spray component. 15 refs., 18 figs., 1 tab.

53199 (UCRL–21214-Vol.1) **Effectiveness of water spray mitigation systems for accidental releases of hydrogen fluoride: Volume 1, Detailed report.** Lawrence Livermore National Lab., CA (USA); Industry Cooperative Hydrogen Fluoride Mitigation/Assessment Program (USA). Water Spray Subcommittee. Jun 1989. 214p. DOE Contract W-7405-ENG-48. Order Number DE90001048. Available from NTIS, PC A11/MF A01 - OSTI.

Accidental releases of pressurized, superheated hydrogen fluoride (HF) can result in initially dense clouds which will typically contain a mixture of HF vapor, aerosol, and droplets. Previous experiments were performed by Amoco Oil Company and Lawrence Livermore National Laboratories (the Goldfish series in 1986) to study atmospheric dispersion of these HF clouds. The present study examines the effect of water application on the mitigation of these clouds. To assess the effectiveness of water application (via either sprays or monitor) in mitigating HF clouds two series of tests were conducted in separate flow chambers. Bench scale experiments identified key variables for testing in larger scale field tests demonstrated that HF releases can be mitigated with water. The impact of numerous design variables on mitigation effectiveness has also been quantified. HF removal efficiencies of 25 to 90+% have been demonstrated at water to HF liquid ratios of 6/1 to 40/1 and higher. 8 refs., 69 figs., 50 tabs.

53200 (UCRL–21214-Vol.2) **Effectiveness of water spray mitigation systems for accidental releases of hydrogen fluoride: Volume 2, Appendices A–D.** Lawrence Livermore National Lab., CA (USA); Industry Cooperative Hydrogen Fluoride Mitigation/Assessment Program (USA). Water Spray Subcommittee. Jun 1989. 184p. DOE Contract W-7405-ENG-48. Order Number DE90001180. Available from NTIS, PC A09/MF A01 - OSTI.

Accidental release of pressurized, superheated hydrogen fluoride (HF) can result in initially dense clouds which will typically contain a mixture of HF vapor, aerosol, and droplets. Previous studies experiments were performed by Amoco Oil Company and Lawrence Livermore National Laboratories (the Goldfish series in 1986) to study atmospheric dispersion of these HF clouds. The present study examines the effect of water application on the mitigation of these clouds. To assess the effectiveness of water application (via either sprays or monitor) in mitigating HF clouds two series of tests were conducted in separate flow chambers. Bench scale experiments identified key variables for testing in a larger facility. The large scale field tests demonstrated that HF releases can be mitigated with water. The impact of numerous design variables on mitigation effectiveness has also been quantified. HF removal efficiencies of 25 to 90+% have been demonstrated at water to HF liquid ratios of 6/1 to 40/1 and higher.

53201 (UCRL–21214-Vol.3) **Effectiveness of water spray mitigation systems for accidental releases of hydrogen fluoride: Volume 3, Appendix E, Water spray test data.** Lawrence Livermore National Lab., CA (USA); Industry Cooperative Hydrogen Fluoride Mitigation/Assessment Program (USA). Water Spray Subcommittee. Jun 1989. 203p. DOE Contract W-7405-ENG-48. Order Number DE90001099. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

Accidental release of pressurized, superheated hydrogen fluoride (HF) can result in initially dense clouds which will typically contain a mixture of HF vapor, aerosol, and droplets. Previous experiments were performed by Amoco Oil Company and Lawrence Livermore National Laboratories (the Goldfish series in 1986) to study atmospheric dispersion of these HF clouds. The present study examines the effect of water application on the mitigation of these clouds. To assess the effectiveness of water application (via either sprays or monitor) in mitigating HF clouds two series of tests were conducted in separate flow chambers. Bench scale experiments identified key variables for testing in a larger facility. The larger scale field tests demonstrated that HF releases can be mitigated with water. The impact of numerous design variables on mitigation effectiveness has also been quantified. HF removal efficiencies of 25 to 90+% have been demonstrated at water to HF liquid ratios of 6/1 to 40/1 and higher.

53202 (UCRL–21214-Vol.5) **Effectiveness of water spray mitigation systems for accidental releases of hydrogen fluoride: Volume 5, Appendix G, Aerosol measurements.** Holve, D.J.; Harvill, T.L. Lawrence Livermore National Lab., CA (USA); INSITEC, San Ramon, CA (USA). Jun 1989. 124p. DOE Contract W-7405-ENG-48. Order Number DE90001098. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

Accidental release of pressurized, superheated hydrogen fluoride (HF) can result in initially dense clouds which will typically contain a mixture of HF vapor, aerosol, and droplets. Previous experiments were performed by Amoco Oil Company and Lawrence Livermore National Laboratories (the Goldfish series in 1986) to study atmospheric dispersion of these HF clouds. The present study examines the effect of water application on the mitigation of these clouds. To assess the effectiveness of water application (via either sprays or monitor) in mitigating HF clouds two series of tests were conducted in separate flow chambers. Bench scale experiments identified key variables for testing in a larger facility. The larger scale field tests demonstrated that HF releases can be mitigated with water. The impact of numerous design variables on mitigation effectiveness has also been quantified. HF removal efficiencies of 25 to 90+% have been demonstrated at water to HF liquid rates of 6/1 to 40/1 and higher. 8 refs., 69 figs., 50 tabs.

53203 (UCRL–21214-Vol.6) **Effectiveness of water spray mitigation systems for accidental releases of hydrogen fluoride: Volume 6, Appendix H, Selected still photographs.** Lawrence Livermore National Lab., CA (USA); Industry Cooperative Hydrogen Fluoride Mitigation/Assessment Program (USA). Water Spray Subcommittee. Jun 1989. 111p. DOE Contract W-7405-ENG-48. Order Number DE90001179. Available from NTIS, PC A06/MF A01 - OSTI.

Accidental releases of pressurized, superheated hydrogen fluoride (HF) can result in initially dense clouds which will typically contain a mixture of HF vapor, aerosol, and droplets. Previous experiments were performed by Amoco Oil Company and Lawrence Livermore National Laboratories (the Goldfish series in 1986) to study atmospheric dispersion of these HF clouds. The present study examines the effect of water application on the mitigation of these clouds. To assess the effectiveness of water application (via either sprays or monitor) in mitigating HF clouds two series of tests were conducted in separate flow chambers. Bench scale experiments identified key variables for testing in a larger facility. The larger scale field tests demonstrated that HF releases can be mitigated with water. The impact of numerous design variables on mitigation effectiveness has also been quantified. HF removal efficiencies of 25 to 90+% have been demonstrated at water to HF liquid ratios of 6/1 to 40/1 and higher.

5003 Radioactive Materials Monitoring and Transport

Refer also to citation(s) 52278, 52280, 53238, 53245

53204 (GSF–22/88) **Reports on background radioactivity measurements in the district of Schwandorf, Bavaria, 1987.** Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Abt. fuer Technischen Strahlenschutz; Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany, F.R.). May 1988. 95p. (In German). Order Number DE90711225. Available from NTIS (US Sales Only), PC A05/MF A01.

The 1987 measuring programme has been enlarged with measurements of Kr-85 in the air and of the content of I-29 in various samples. The measured values continue to show the effects of the reactor accident in Chernobyl. Though the concentration of the activities of Cs-134 and Cs-137 has fallen in nearly all food samples, by comparison with the values of 1986, the measured values are still noticeably higher than earlier values. The amount of the concentration of activity not only depends on the type of foodstuff, but it shows, just as in 1986, considerable local and periodic fluctuations. The concentration of activity decreased considerably in Spring 1987, after the increase of Cs-134 and Cs-137 concentrations in milk, in Autumn 1986. Due to experiences obtained from surface nuclear weapons tests, Cs-134 and Cs-137 resulting from the Chernobyl accident may be expected to constitute the essential fraction of all artificial radioactive substances in the samples within the next few years as well. (orig./HP).

53205 (IPPJ-REV–3, pp. 39-45) **Atmospheric tritium in three different chemical forms in Fukuoka.** Okai, Tomio (Kyushu Univ., Fukuoka (Japan). Faculty of Engineering); Takashima, Yoshimasa. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

A portable tritium sampling system was developed for the stepwise collections of tritiated water vapor (HTO), tritiated hydrogen (HT) and tritiated hydrocarbons (CH_3T) in the atmosphere. According to the system, the collection efficiencies of HTO, HT and CH_3T were all estimated to be nearly 100%. Tritium concentrations of HTO, HT and CH_3T in the atmosphere in Fukuoka were measured from 1984 to the present. Atmospheric HTO concentration varies within range from 0.15 to 1.64 pCi/m^3-air of from 22 to 86 pCi/l-H_2O. HTO concentrations expressed in pCi/m^3 show the trend that they are higher in summer and lower in winter. This trend is similar to the variation of atmospheric absolute humidity expressed in g/m^3-air. On the other hand, HT and CH_3T concentrations generally show no seasonal variations with the almost constant values of 0.78-1.90 pCi/m^3 and 0.21-0.86 pCi/m^3, respectively. Annual averaged concentrations of atmospheric tritium expressed in pCi/m^3 are about 0.55, 1.14 and 0.38 for HTO, HT and CH_3T, respectively. On the other hand, the specific activities written in tritium unit (TU) are about 16, 10^6 and 4 x 10^4 for HTO, HT and CH_3T, respectively. These facts obviously indicate that not only HTO but also HT should be considered to estimate the radiation effect of tritium to human being, and that the origins of tritium involved in these species are quite different. (author).

53206 (JAERI-M–89-041) **Analysis of the wind data and estimation of the resultant doses from the supersonic anemometer. A comparison study of the supersonic and propeller wind data.** Hu, Shze Jer; Katagiri, Hiroshi; Kobayashi, Hideo. Japan Atomic Energy Research Inst., Tokyo (Japan). Apr 1989. 55p. Order Number DE90709989. Available from NTIS (US Sales Only), PC A04/MF A01.

Statistical analyses and comparisons of the wind data obtained by the propellar and supersonic anemometers for the year of 1987 in Japan Atomic Energy Research Institute, Tokai Establishment were performed. The resultant average air concentrations and ground level external γ exposure rates due to the radioactive releases for the normal operation of a nuclear power plant are overestimated when calculated using the properller wind data. The difference is due to the influence of low wind speeds. If the frequencies of low wind speed are large, wind data observed by the supersonic, which could measure even low wind speed more precisely then the propeller, should be used in the atmospheric dispersion analysis to yield a more accurate and realistic estimation of the air concentration and ground level external γ exposure rate. The analysis also shows that the adult thyroid exposure dose of the postulated accident is sufficiently accurate and valid when estimated basing on the contributions of individual iodine nuclides without considering their decay and using the supersonic wind data without having to modify the assumed mean wind speed of the calm. For the external γ whole body exposure of the postulated accident, accurate and realistic estimation should base on the contributions of individual radionuclides with their decay considered and use the supersonic wind data for atmospheric dispersion analysis. (author).

53207 (JAERI-M–89-062) **Development of a three-dimensional local scale atmospheric model with turbulence closure model.** Yamazawa, Hiromi. Japan Atomic Energy Research Inst., Tokyo (Japan). May 1989. 27p. Order Number DE90710045. Available from NTIS (US Sales Only), PC A03/MF A01.

Through the study to improve SPEEDI's capability, a three-dimensional numerical atmospheric model PHYSIC (Prognostic HYdroStatic model Including turbulence Closure model) was developed to apply it to the transport and diffusion evaluation over complex terrains. The detailed description of the atmospheric model

was given. This model consists of five prognostic equations; the momentum equations of horizontal components with the so-called Boussinesq and hydrostatic assumptions, the conservation equations of heat, turbulence kinetic energy and turbulence length scale. The coordinate system used is the terrain following z_* coordinate system which allows the existence of complex terrain. The minute formula of the turbulence closure calculation, the surface layer process, the ground surface heat budget, and the atmospheric and solar radiation were also presented. The time integration method used in this model is the Alternating Direction Implicit (A.D.I.) method with a vertically and horizontally staggered grid system. The memory storage needed to execute this model with 31 x 31 x 16 grid points, five layers in soil and double precision variables is about 5.3 MBytes. The CPU time is about 2.2×10^{-5} s per one step per one grid point with a vector processor FACOM VP-100. (author).

53208 (LLNL–90001492) **Diode calibration manual.** Brunk, J.L. Lawrence Livermore National Lab., CA (USA). Sep 1989. 1044p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. (M–262). Order Number DE90001492. Available from NTIS, PC A99/MF A01 - OSTI.

This procedure is not for the faint of heart. It is a time consuming, complex series of journeys through advanced GAMANAL and the vagueness of analyzer electronics. A knowledge of TRIX AC, DLTV, and IMP on the Octopus system and DSCOPE, PE2, and Symphony on a PC class machine is required. Be aware that the example in this document is a condensation of information that takes up four feet of shelf space. In the attempt to convert the nomenclature of the 7600 version of GAMANAL to that of the CRAY version, there will be confusion with some of the terms used. The 7600 versions relied on punched cards to a great extent where the CRAY version doesn't use them at all. In order not to introduce a new set of nomenclature, I have changed the reference from card to card image. I hope that this will cause the least impact on the vernacular and cause the least amount of confusion possible. This document is a rewritten update of an unpublished document by Bob Wikkerink in 1980. His document was the only written record of the procedures needed to calibrate the Environmental Sciences Low Level Counting Facility. This document updates and expands this information.

53209 (UCRL–101215-Rev.1) **Evaluation of an emergency response model with instantaneous air concentrations during stable conditions: Revision 1.** Baskett, R.L.; Mitchell, C.S. Lawrence Livermore National Lab., CA (USA). Aug 1989. 6p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract W-7405-ENG-48. (CONF-891103–30-Rev.1: Winter meeting of the American Nuclear Society, San Francisco, CA (USA), 26-30 Nov 1989). Order Number DE90001053. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The STABLE project (STAble Boundary Layer Experiment) is a multiyear research effort planned by the Department of Energy to study the effects of turbulence and diffusion on plumes in the stable boundary layer. Conducted by the Savannah River Laboratory (SRL) at Savannah River Plant (SRP), near Aiken, South Carolina, in April 1988, the first STABLE field experiment provides a unique tracer data set for evaluating dispersion models. The unique aspect of the experiment was that instantaneous air concentrations were collected. When short-term toxicity is an issue in an accidental release, emergency response requires consideration of peak concentrations. The purpose of this paper is to show the comparison of the SRL STABLE data with Lawrence Livermore National Laboratory's (LLNL) Atmospheric Release Advisory Capability (ARAC) emergency response dispersion models. 2 refs., 1 fig.

53210 Detection of uranium from cosmos-1402 in the stratosphere. Leifer, R. (Dept. of Energy, New York, NY (USA)); Juzdan, Z.R.; Kelly, W.R.; Fassett, J.D.; Eberhardt, K.R. *Science (Washington, D.C.) (USA),* 238: 512-514 (23 Oct 1987).

The nuclear reactor from the Soviet radar reconnaissance satellite, Cosmos-1402, reentered the earth's atmosphere on 7 February 1983 and disintegrated over the South Atlantic Ocean. The reactor was powered by approximately 50 kilograms of uranium-235 (^{235}U). In an effort to determine the fate of the reactor core, a series of aerosol samples were collected at altitudes between 27 and 36 kilometers in the Northern Hemisphere approximately 1.1 years late by high-altitude balloons. At an altitude of 36 kilometers a 53 ± 20% excess in the ^{235}U concentration was measured. The total excess of ^{235}U in the stratosphere was calculated to be 44 ± 15 kilograms. 20 refs., 1 fig., 5 tabs.

5004 Thermal Effluents Monitoring and Transport

Refer also to citation(s) 53150

5005 Site Resource and Use Studies

53211 (PB–89-202691/XAB) **National water summary 1986: Hydrologic events and ground-water quality. Annual report.** Moody, D.W.; Carr, J.; Chase, E.B.; Paulson, R.W. Geological Survey, Reston, VA (USA). Water Resources Div. 1988. 571p. (USGS/WATER-SUPPLY-PAPER–2325). Available from NTIS, PC A24.

Also available from Supt. of Docs. See also PB–87-198552. Color illustrations reproduced in black and white.

This report is the fourth of an annual series describing the Nation's water resources, focuses on ground-water quality, and summarizes the ambient quality of ground water in the principal water-supply aquifers and describes the nature and extent of ground-water contamination in each State, the District of Columbia, and the territories. Each summary contains multicolor illustrations that show selected geographic features and the 1985 population distribution; the location of principal aquifers and presentations of data related to water quality in those principal aquifers; and the location of selected waste sites, areas of naturally impaired groundwater quality, and areas reflecting human-induced contamination. Also summarized are the State agencies, laws, and regulations involved in ground-water-quality management.

5006 Regulations

Refer also to citation(s) 51653

53212 (EPA–450/3-89-31) **Benzene emissions from coke by-product recovery plants, benzene storage vessels, equipment leaks, and ethylbenzene/styrene process vents: Background information and responses to technical comments for 1989 final decisions: Final EIS.** Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards. Aug 1989. 189p. Sponsored by Environmental Protection Agency. Available from NTIS, PC A09/MF A01 - OSTI.

Final decisions have been made on regulation of benzene emissions from existing and new coke by-product recovery plants, benzene storage vessels, equipment leaks, and ethylbenzene/styrene process vents. These decisions implement Section 112 of the Clean Air Act and are based on the Administrator's determination of June 8, 1977 that benzene presents a significant risk to human health as a result of air emissions from one or more stationary source categories, and is therefore a hazardous air pollutant. This document contains a summary of the comments on the proposal of these standards in the Federal Register, the Environmental Protection Agency's response to these comments, and a summary of the health, environmental and economic impacts of the final standards.

53213 (PB–89-167894/XAB) **Technology evaluation report: SITE (Superfund Innovative Technology Evaluation) program demonstration test. The American Combustion Pyretron Thermal Destruction System at the US EPA's (Environmental Protection Agency's) combustion research facility.** Waterland, L.; Lee, J.W. Acurex Corp., Jefferson, AR (USA). Apr 1989. 248p. Available from NTIS, PC A11/MF A01.

A series of demonstration tests of the American Combustion, Inc., Thermal Destruction System was performed under the SITE program. This oxygen-enhanced combustion system was retrofit to the rotary-kiln incinerator at EPA's Combustion Research Facility. The system's performance was tested firing contaminated soil from the Stringfellow Superfund Site, both alone and mixed with a coal tar waste (KO87). Comparative performance with conventional incinerator operation was also tested. Compliance with the incinerator performance standards of 99.99% principal organic hazardous constituents (POHC) destruction and removal efficiency and particulate

emissions of less than 180 mg/dscm at 7% O2 was measured for all tests. The Pyretron system was capable of in-compliance performance at double the mixed waste feedrate and at a 60% increase in batch waste charge mass than possible with conventional incineration. Scrubber blowdown and kiln ash contained no detectable levels of any of the POHCs chosen.

53214 (PB–89-167902/XAB) **Technology evaluation report: SITE (Superfund Innovative Technology Evaluation) program demonstration test. Shirco pilot-scale infrared incineration system at the Rose Township Demode Road Superfund site. Volume 1. Final report.** Rosenthal, S. Enviresponse, Inc., Livingston, NJ (USA). Apr 1989. 125p. Available from NTIS, PC A06/MF A01.

See also Volume 2, PB–89-167910.

A Superfund Innovative Technology Evaluation (SITE) Program demonstrated the Shirco Infrared System (pilot plant) for thermally processing PCB waste at Rose Township, Michigan. The process was evaluated by the U.S. EPA and is reported in Volume I of the report. Results reported in Volume I indicated that PCB was removed from the feed material with a DRE greater than 99.99%. The destructive ratio (percent of PCB in the ash compared to feed) was greater than 83% resulting in a less than 1 ppm concentration in the ash. Particulate emissions, products of incomplete combustion (PICs) and acid-gas emissions were below any standards. Metals in the ash leached by the TCLP and EP Tox. were below suggested standards.

53215 (PB–89-167910/XAB) **Technology evaluation report: SITE (Superfund Innovative Technology Evaluation) program demonstration test. Shirco pilot-scale infrared incineration system at the Rose Township Demode Road Superfund site. Volume 2. Final report.** Rosenthal, S. Enviresponse, Inc., Livingston, NJ (USA). Apr 1989. 599p. Available from NTIS, PC A25/MF A01.

See also Volume 1, PB–89-167902.

The performance of the Shirco pilot-scale infrared thermal destruction system has been evaluated at the Rose Township, Demode Road Superfund Site and is presented in the report. The waste tested consisted of solvents, organics and heavy metals in an illegal dump site. Volume II is the test program, copies of the original operating data, sampling analysis report and quality assurance plan.

53216 (PB–89-207914/XAB) **Review of the national ambient air-quality standards for lead: exposure analysis methodology and validation. Staff report (Final).** Cohen, J. Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards. Jun 1989. 172p. (EPA–450/2-89/011). Available from NTIS, PC A08/MF A01.

This report summarizes relevant information on multi-media lead exposure and presents the modeling methodologies that EPA staff believes should be considered for the review of the national ambient air-quality standards for lead. Results of validating one of these methodologies are also presented. The significant downward trends in gasoline lead emissions and lead concentrations in the diet are accounted for in these methodologies. Young children, pregnant women (as exposure surrogates for the fetus), and middle-aged men are identified as particularly susceptible to lead. Three different exposure methodologies, developed from a wide variety of data are described: the uptake/biokinetic and aggregate air lead models, both applicable to young children, and the disaggregate air lead model, which is applicable to both young children and adults. The uptake/biokinetic model allows explicit projections of future lead concentrations in different media and in turn can estimate the impacts of these changes on different age groups of children. It is this flexibility that makes the uptake/biokinetic model adaptable for a wide range of predictive exposure assessments and why it was the focus of the validation exercises described in the paper. Results of these exercises indicate good concordance between predicted and observed blood lead-levels in children living near different lead point sources.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

53217 (CONF-8909227–1) **The systems approach to environmental assessment.** O'Neill, R.V. Oak Ridge National Lab., TN (USA). 1989. 34p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Integrated environmental management meeting; Aiken, SC (USA); 26-28 Sep 1989. Order Number DE90000579. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The systems approach in ecology is both a methodology and a holistic mindset. As a methodology, it utilizes mathematical and computer models to simulate natural ecosystems. As a mindset, it focuses on the total functioning and overall properties of the ecosystem. The distinction between methodology and mindset forms a convenient outline for the present review. Under the rubric of methodology, I will discuss the applicability of ecological models to environmental assessment. Under holistic mindset, I will consider the feasibility of assessing impacts on overall ecosystem function. In both cases, we will find that the systems approach has much to offer in assessing environmental impacts. The approach encourages a comprehensive viewpoint and avoids the pitfalls that result from focusing too closely on a single population or process. At the same time, we will find that the systems approach is no panacea. No single approach should be relied upon (or ignored) in addressing complex assessment issues. 92 figs.

53218 (DP-MS–88-239) **Home range: A spatially continuous fractal approach.** Loehle, C.; Ostee, R.; Gilman, T.L. Westinghouse Savannah River Co., Aiken, SC (USA). [1989]. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-8908155–1: Ecological Society of America meeting, Toronto (Canada), 3 Aug 1989). Order Number DE89017861. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A great deal of work has been done on home range quantification and description. All current methods, however, share an approach that leads to fundamental difficulties. We develop a completely new conception of the home range that is spatially continuous rather than point-oriented and that incorporates sample error. It leads to a more robust measure of competition than overlap of utilization distributions. Seasonal movements and habitat relations can be inferred even from rather approximate telemetry data. For studies of travel distance or home range (territory size), however, accuracy of the method is important. In particular, estimation of foraging times and energetics calculations based on travel distance depend on the accuracy of location estimates. For any given pair of points for which travel distance is to be calculated, two types or error interfere with a straight line distance measure. First, point estimates have associated measurement error (point estimate error) which may be quite large for telemetry data. Second, animals rarely travel in straight lines. The path actually taken from point A to B is typically much longer than the straight line from A to B unless A and B were measured quite closely in time. This is interval estimate error which creates an unusual sampling problem. Unlike more accurate measurement of something like mass, more "accurate" interval estimation achieved by increasing the sample frequency results in an increase in total length. This divergence is characteristic of fractal objects. Other such diverging measures include cloud boundaries, coastlines, surface "area" in mountainous terrain, and other irregular objects. Note that increasing the time between samples until statistical independence is achieved causes even more loss of information concerning true distances traveled between sample points. 24 refs., 1 fig.

53219 (INIS-mf–12006, pp. 155) **Fission track and TL analysis.** Wagner, G.A.; Hejl, E.; Prokein, J.; Houte, P. van den. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Fission track analyses of apatites sampled at different depths reveals the uplift history of the deep drilling area. Recent thermal events are discovered by thermoluminescence studies. (orig.).

53220 (INIS-mf–12006, pp. 155-156) **Mass spectrometric analysis of noble gas isotopes.** Heusser, E.; Kirsten, T.; Richter, H.; Oehm, J. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Analysis of all stable noble gas isotopes in KTB core rocks provides a good opportunity to characterize the geochemical reservoir 'continental crust' and to study mixing and transport processes between the various earth reservoirs. (orig.).

53221 (INIS-mf–12006, pp. 156-157) **TL-dating of ancient copper slags.** Lorenz, I.B.; Wagner, G.A. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

TL ages of copper slags are commonly different from independently known ages, which is due to inhomogeneous distribution of radioactive constituents and inhomogeneous TL sensitivity of the TL phosphors. (orig.).

53222 (INIS-mf–12006, pp. 157) **Thermoluminescence dating of quaternary sediments and paleolithic sites.** Zoeller, L.; Wagner, G.A. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

The loess chronology of the latest glacial periods was established in great detail by thermoluminescence dating. Horizons containing Middle and Upper Palaeolithic finds were successfully dated. (orig.).

53223 (INIS-mf–12006, pp. 157-158) **Development and transfer of the early copper metallurgy.** Begemann, F. (Max-Planck-Institut fuer Chemie (Otto-Hahn-Institut), Mainz (Germany, F.R.)); Schmitt-Strecker, S.; Lorenz, I.; Krajnovic, D.; Lutz, J.; Pernicka, E.; Philipps, R.; Wagner, G.A. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Studies on early copper metallurgy in the Anatolian and Agean areas include chemical and isotopic analyses of ores and artefacts as well as field work. (orig.).

53224 (INIS-mf–12006, pp. 158) **Geochemical, lead, and sulfur isotope classification of polymetallic ore deposits from NE Greece.** Chalkias, S.; Wagner, G.A.; Pernicka, E. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Trace element as well as sulfur and lead isotope characteristics from polymetallic ore deposits show no significant discrimination of deposits from different tectonic zones. (orig.).

53225 (ORNL–6011) **Nevada applied ecology group publications.** Chilton, B.D.; Pfuderer, H.A.; Cox, T.L. Oak Ridge National Lab., TN (USA). Sep 1989. 246p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OR21400. (NVO/AEIC–264). Order Number DE90002111. Available from NTIS, PC A11/MF A01 - OSTI; GPO Dep.

Since January 1972, the Nevada Applied Ecology Information Center (NAEIC), Information Research and Analysis Section, Health and Safety Research Division, Oak Ridge National Laboratory, has provided technical information support to the Nevada Applied Ecology Group (NAEG) relevant to the behavior of specific radionuclides, primarily plutonium and americium, in the environment, with special emphasis on pathways to man. This bibliography represents a summary of the biomedical and environmental studies conducted by the NAEG and its contractors. The bibliography focuses on research sponsored by the NAEG. Subject areas of the publications include cover studies of soil, vegetation, animals, microorganisms, resuspension, and meteorology. All references in this publication are stored in a computerized form that is readily available for searches upon request to NAEG and it contractors. 558 refs.

53226 (ORNL/FTR–2496) **[Collection of high quality acoustical records for honeybees]: Foreign trip report, January 24–February 1, 1987.** Kerr, H.T.; Buchanan, M.E. Oak Ridge National Lab., TN (USA). 19 Feb 1987. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89017299. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

High quality acoustical data records were collected for both European and Africanized honeybees under various field conditions. This data base was needed for more rigorous evaluation of a honeybee identification technique previously developed by the travelers from preliminary data sets. Laboratory-grade recording equipment was used to record sounds made by honeybees in and near their nests and during foraging flights. Recordings were obtained from European and Africanized honeybees in the same general environment. Preliminary analyses of the acoustical data base clearly support the general identification algorithm: Africanized honeybee noise has significantly higher frequency content than does European honeybee noise. As this algorithm is refined, it may result in the development of a simple field-portable device for identifying subspecies of honeybees. Further, the honeybee's acoustical signals appear to be correlated with specific colony conditions. Understanding these variations may have enormous benefit for entomologists and for the beekeeping industry.

5102 Chemicals Monitoring and Transport

Refer also to citation(s) 51673, 51731, 51860, 53168, 53262, 53263

53227 (CONF-8909214–1) **The food chain as a source of human exposure to organic chemicals.** Hattemer-Frey, H.A.; Travis, C.C. Oak Ridge National Lab., TN (USA). [1989]. 61p. Sponsored by Environmental Protection Agency. DOE Contract AC05-84OR21400. From Washington risk assessment conference; Arlington, VA (USA); 27 Sep 1989. Order Number DE90001074. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Although human exposure to environmentally released pollutants can occur via several pathways including, inhalation, ingestion of contaminated food items, infant consumption of mother's milk, and dermal absorption, of particular concern are potential exposures from ingesting contaminated food items, since the food chain has been shown to be a primary source of human exposure to a large class of organics, including DDT, TCDD, pentachlorophenol, benzo(a)pyrene, and most pesticides. For risk assessment purposes, an important objective in evaluating the environmental behavior and fate of various pollutants is predicting the major pathways and extent of human exposure. Many chemicals cycle in the environment with cross-media transfers occurring between air, water, soil, and biota. As a result of this cycling behavior and a chemical's presence in various environmental media, human exposure often results from multiple sources. We found that 50–80% of all chemicals released into the environment result in human exposure through multiple media. The purpose of this presentation is to provide a perspective on the food chain as a source of human exposure to organic chemicals chronically released into the environment. 121 refs., 3 figs., 9 tabs.

53228 (PNL–7134) **Resource Conservation and Recovery Act ground-water monitoring projects for Hanford facilities: Progress report, April 1–June 30, 1989.** Smith, R.M.; Bates, D.J.; Lundgren, R.E. Pacific Northwest Lab., Richland, WA (USA). Sep 1989. 254p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. Order Number DE90000988. Available from NTIS, PC A12/MF A01 - OSTI; GPO Dep.

This report describes the progress of 13 Hanford ground-water monitoring projects for the period April 1 to June 30, 1989. These projects are for the 300 area process trenches (300 area), 183-H solar evaporation basins (100-H area), 200 areas low-level burial grounds, nonradioactive dangerous waste landfill (southeast of the 200 areas), 1301-N liquid waste disposal facility (100-N area), 1324-N surface impoundment and 1324-NA percolation pond (100-N area), 1325-N liquid waste disposal facility (100-N area), 216-A-10 crib (200-east area), 216-A-29 ditch (200-east area), 216-A-36B crib (200-east area), 216-B-36B crib (200-east area),

216-B-3 pond (east of the 200-east area), 2101-M pond (200-east area), grout treatment facility (200-east area).

53229 (UCID–21764) **Remedial investigation of landfill Pit 8 Lawrence Livermore National Laboratory Site 300.** Environmental Restoration Series. Taffet, M.J. Lawrence Livermore National Lab., CA (USA). Aug 1989. 112p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90000932. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This report documents our investigation of the geology and hydrogeology beneath inactive landfill Pit 8 at Lawrence Livermore National Laboratory Site 300. Site 300 is located about 15 miles east of Livermore, California, in rugged, rural terrain on the east side of the Altamont Hills; this remote facility is used for the testing of explosives and materials to support LLNL's national defense programs. Landfill Pit 8 is located in San Joaquin County in the northeastern portion of Site 300. Since August 1987, trichloroethylene (TCE) has been detected in ground water from one well to a maximum of 6 μg/L. Ground water from a second well has contained lower concentrations of TCE since the last quarter of 1988. We began this investigation in mid-1988 to determine the extent and sources of TCE at the landfill site and to define local hydrogeology. This report presents the results and conclusions of the investigation. 17 refs., 6 figs., 2 tabs.

53230 (UCRL–101850) **Cooperative, multi-disciplinary problem solving for chemical accidents.** Koopmam, R.P. Lawrence Livermore National Lab., CA (USA). Aug 1989. 16p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8907103–11: Technology-based confidence building: energy and environment, Santa Fe, NM (USA), 9-14 Jul 1989). Order Number DE90001513. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Chemical accidents will always occur as long as hazardous chemicals continue to play an important role in our culture. The frequency of such events must be kept very low in order for the public to continue to accept the risks they create. The most important and first line of defense must always be prevention. This is the industry position and where industry puts most of its resources. It is also, in my opinion, the proper focus for most of the effort in hazardous chemical safety and must be maintained as a vital ongoing effort. It is, however, mainly up to the various industries to maintain this work. Thus, the solution to the problem of chemical accidents is cooperative, multi-disciplinary problem solving, involving industry, government, researchers, and the public. If this is done well, it will build confidence in the technology which dominates modern life. This effort must be multi-national because the problem is world-wide and because industrialized countries are exporting their technology to the developing world. It must be multi-industry because any particular hazardous chemical is often used in several different industries. It is highly multi-disciplinary, involving chemical engineering, atmospheric sciences, mathematics, toxicology, and a number of other disciplines. 11 refs., 1 tab.

5103 Radioactive Materials Monitoring and Transport

Refer also to citation(s) 51753, 51808, 51809, 51812, 51813, 51845, 51866, 51869, 52278, 52311, 52314, 52711, 52712, 52715, 52717, 52735, 53204, 53228, 53421, 53879, 53881, 53882

53231 (BALUF-STS–87-06) **CS-137 in Austrian domestic animals: determination of transfer parameters and meat contamination by live animal measurements.** Henrich, E. Bundesanstalt fuer Lebensmitteluntersuchung und -forschung, Vienna (Austria). 19 Oct 1987. 11p. Order Number DE90604898. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Soon after the Chernobyl accident several programs were initiated by provincial and federal authorities to check the validity of transfer factors and biological lifetimes as given in the literature; to test the possibility of reducing the cesium content in meat and milk by chemical agents; and to determine the cesium content of meat in live animals to assist of slaughtering decisions. Details and results of these programs are presented. 1 tab., 3 figs., 9 refs.

53232 (CONF-8710458–) **Studies on environmental radioactivity and health impact with reference to Chernobyl accident. Proceedings of the meeting organized by the Italian (AIRP) and French (SFRP) organizations of protection against radiation.** ENEA, Rome (Italy). Jul 1988. 456p. (In Italian French English). From Studies on environmental radioactivity and health impact with reference to Chernobyl accident meeting; Rome (Italy); 12-13 Oct 1987. Order Number DE89793223. Available from NTIS (US Sales Only), PC A20.

The studies deal with the following topics: Chernobyl fallout monitoring in the environment of Western Europe (in particular, measurements of cesium 134 and 137 ground and air contamination, cesium 137 and iodine 131 contamination of the food chain); whole body counting; methodology, accuracy and reliability of dose equivalent evaluations; the efficiency of the Italian national radiation monitoring network and national radiation protection measures; comparisons of the radiation protection policies of European nations; the planning, standardization and integration of European radiation monitoring networks; the drawing up of emergency plans to ensure adequate protection of the public, on an international level, against radiation hazards. Separate abstracts were prepared for 18 papers of this report.

53233 (CONF-8710458–, pp. 33-51) **Environmental radioactivity monitoring after Chernobyl in Italy.** Cigna, A.A. (ENEA, Saluggia (Italy)); Spezzano, P.; Dominici, G. ENEA, Rome (Italy). Jul 1988. (In Italian). From Studies on environmental radioactivity and health impact with reference to Chernobyl accident meeting; Rome (Italy); 12-13 Oct 1987. In *Studies on environmental radioactivity and health impact with reference to Chernobyl accident. Proceedings of the meeting organized by the Italian (AIRP) and French (SFRP) organizations of protection against radiation.* Order Number DE89793139. Available from NTIS (US Sales Only), PC A20.

Environmental radioactivity (in particular, iodine 131 concentrations) measurements made, following the Chernobyl accident, by the Radiation Protection Division of the CCR Ispra (Italy) and by the health Physics Service of the CRE Saluggia ENEA (Italy), on samples collected in the north-western parts of Italy, are reported. The general structure of the environmental laboratories, the choice of samples and collection techniques are discussed in order to standardize the methodologies and make the measurements comparable.

53234 (CONF-8710458–, pp. 373-378) **Aerial monitoring of terrestrial radioactive contamination due to Chernobyl incident.** Bertocchi, A.; Frullani, S.; Mazzini, F.; Morichi, M.; Salusest, B. ENEA, Rome (Italy). Jul 1988. (In Italian). From Studies on environmental radioactivity and health impact with reference to Chernobyl accident meeting; Rome (Italy); 12-13 Oct 1987. In *Studies on environmental radioactivity and health impact with reference to Chernobyl accident. Proceedings of the meeting organized by the Italian (AIRP) and French organizations of protection against radiation.* Order Number DE89793236. Available from NTIS (US Sales Only), PC A20.

A description is given of the aerial monitoring equipment and data acquisition system used to measure cesium 134 and 137 ground contamination in Italy in May 1986. The equipment (H.V. fed NaI(Tl) crystal scintillator, linear amplifier, analog-to-digital converter and a Le Croy 3500 minicomputer) and methodology adopted were chosen based on the experience gained by other countries in the monitoring of the contamination due to the uncontrolled re-entry of the COSMOS satellites in 1978 and 1983. The equipment was mounted with a special anti-vibration support structure on an Augusta-Bell AB412 helicopter. The aerial system was designed to monitor ground contamination over large areas, pinpoint individual sources in various locations scattered over vast areas and to take in-flight samples of radioactive clouds.

53235 (CONF-8710458–, pp. 415-419) **Radioecological consequences of Chernobyl: Review of radiation monitoring - civil defense activities in Italy.** Benassai, S. (ENEA, Rome (Italy)); Breuer, F.; Piermattei, S.; Susanna, A.; Trenta, G. ENEA, Rome (Italy). Jul 1988. (In Italian). From Studies on environmental radioactivity and health impact with reference to Chernobyl accident meeting; Rome (Italy); 12-13 Oct 1987. In *Studies on environmental*

radioactivity and health impact with reference to Chernobyl accident. Proceeding of the meeting organized by the Italian (AIRP) and French (SFRP) organizations of protection against radiation. Order Number DE89793238. Available from NTIS (US Sales Only), PC A21/MF A01.

This paper comments on information provided by ENEA-DISP (Italian Nuclear Agency-Radiation Protection) which deals with the ecological and biological consequences of the Chernobyl accident in Italy. The measured contamination levels regard iodine 131 and cesium 137 concentrations in air, vegetables and milk. Equivalent dose estimates are given for population in the north, center and south of Italy. The accuracy of these measurements is reviewed and comparisons are made with values obtained in other countries. Suggestions are made, calling for the creation of an integrated emergency plan and stressing the need for improved modalities of information gathering, interpretation and dissemination on a national level.

53236 (CONF-8710458–, pp. 465-474) **Basis of measures (radiation protection) adopted by Italy following the Chernobyl accident.** Campos Venuti, G. (Ist. Superiore di Sanita', Rome (Italy)); Parisi, A.; Susanna, A. ENEA, Rome (Italy). Jul 1988. (In Italian). From Studies on environmental radioactivity and health impact with reference to Chernobyl accident meeting; Rome (Italy); 12-13 Oct 1987. In *Studies on environmental radioactivity and health impact with reference to Chernobyl accident. Proceedings of the meeting organized by the Italian (AIRP) and French (SFRP) organizations of protection against radiation.* Order Number DE89793239. Available from NTIS (US Sales Only), PC A20.

This paper summarizes the radiation monitoring activities carried out and precautions taken in Italy immediately following the Chernobyl accident. Comments are made on the efficacy of the Italian monitoring system and on the accuracies of measurements of iodine 131, cesium 134 and 137 concentrations in air, milk, vegetables and forage. The methodology and accuracy of dose equivalent evaluation are also reviewed. The report cites the need for better organized national monitoring network employing standardized methods and equipment and on improved nationwide system of information gathering, interpretation and dissemination to the public.

53237 (DOE/EH–0107) **Assessment of environmental conditions at the Rocky Flats Plant, Golden, Colorado.** USDOE Special Assignment Environmental Team, Washington, DC (USA). Aug 1989. 478p. Sponsored by U.S. DOE Environment Health & Safety. Order Number DE90000987. Available from NTIS, PC A21/MF A01 - OSTI; GPO Dep.

The Environmental Team has undertaken audit and sampling/monitoring activities to perform an assessment of environmental conditions at the Rocky Flats Plant (RFP). The assessment was conducted from June 6, through July 21, 1989. The objectives of these activities were to determine: whether or not any imminent threat exists to public health or the environment as a result of RFP activities; if RFP operations are being conducted in accordance with applicable environmental requirements and best management practices; and the current status of previously identified environmental problems. In addition, existing environmental management programs at RFP were evaluated. Weaknesses or gaps in the programs were identified and recommendations developed.

53238 (FS–89-50-AKU) **Recommendations for a revision of the Guideline on Emission and Environmental Impact Monitoring of Nuclear Facilities. Statement of the Working Group on Environmental Monitoring.** Fachverband fuer Strahlenschutz e.V. Publikationsreihe Fortschritte im Strahlenschutz. Narrog, J.; Heinemann, K.; Winter, M.; Herrnberger, V.; Haag, J.; Czerwinski, N. Fachverband fuer Strahlenschutz e.V., Karlsruhe (Germany, F.R.); Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Sicherheit. Jul 1989. 32p. (In German). Order Number DE90711754. Available from NTIS (US Sales Only), PC A03/MF A01.

The Guideline on Emission and Environmental Impact Monitoring of Nuclear Facilities (GMBl p. 668, Nov. 26, 1979), published ten years ago, mainly provides for plant related monitoring of the environment. It is analysed, whether or not the Guideline has proved its worth and which revisions should be recommended as a result of new findings, experiences and more recent developments. Although the Guideline as a whole has proved to be adequate and reasonable, a number of modifications seem to be appropriate, some of them even highly necessary. The appendix contains a comparison of essential dose factors 1979 and 1989. (orig./HP).

53239 (IAEA-AL–019, pp. 181-183) **Some of the activities of the Radiochemistry Section at the Atominstitute of the Austrian Universities related to rapid methods for monitoring radionuclides in food and environmental samples.** Buchtela, K. (Atominstitut der Oesterreichischen Universitaeten, Vienna (Austria)). International Atomic Energy Agency, Seibersdorf (Austria). Laboratories. 1989. (CONF-880992–: Cogeneration applications workshop, Vienna (Austria), 1-2 Sep 1988). In *Report of the consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna, 5-9 September 1988.* Order Number DE90603824. Available from NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS.

Monitoring radionuclides in food and environmental samples is part of the routine analysis programme since the implementation of the Radiochemistry Group at the Atominstitute in 1960. In the surrounding of the laboratories of the Atominstitute environmental radioassay had to be carried out even before any work with radionuclides had been started. Determination of radionuclides, gamma-spectrometry and strontium-90 determinations in food had been made from Austrian crops to be exported especially to the USSR.

53240 (KURRI-TR–316) **Papers presented at the intensive seminar on tree rings.** Noda, Masato (ed.). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Mar 1989. 100p. (In Japanese). (CONF-8811269–: Intensive seminar on 'tree rings', Kumatori (Japan), 29-30 Nov 1988). Order Number DE90705931. Available from NTIS (US Sales Only), PC A05/MF A01.

This document compiles individual presentations given at the Intensive Seminar on Tree Rings held at Kumatori, Osaka on November 29 and 30, 1988.

53241 (LA-UR–89-3049) **Migration of fission products at the Nevada Test Site: Detection with an isotopic tracer.** Thompton, J.L.; Gilmore, J.S. Los Alamos National Lab., NM (USA). [1989]. 7p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. (CONF-891120–1: Migration '89: 2nd international conference on chemistry and migration behavior of actinides and fission products in the geosphere, Monterey, CA (USA), 6-10 Nov 1989). Order Number DE90000601. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Researchers at Los Alamos National Laboratory are studying the migration of fission products away from explosion cavities formed by underground nuclear tests at the Nevada Test Site. In some cases, the isotopic composition of the fission products or activation products associated with a particular test are distinctive and we may identify them many years after the event. In this paper we describe a case in which we used rhodium isotopes to identify the source of radioactive material that had moved some 350 m from the explosion site. 4 refs., 2 figs., 2 tabs.

53242 (ORNL/FTR–2805) **[The effects of ionizing radiation on terrestrial and freshwater organisms]: Foreign trip report, January 15–23, 1988.** Blaylock, B.G. Oak Ridge National Lab., TN (USA). 4 Feb 1988. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89017395. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler was invited by the International Atomic Energy Agency (IAEA) to attend an Advisory Group Meeting on "The Effects of Ionizing Radiation on Terrestrial and Freshwater Organisms and Ecosystems." The traveler and Dr. Ward F. Whicker of Colorado State University had prepared a draft document on the subject that was to be reviewed by the Advisory Group. The purpose of the document was to address the statement that by protecting humans with radiological standards, we are automatically protecting natural populations of terrestrial and aquatic organisms and ecosystems. In addition, the document was to include a review of the literature on the effects of radiation on terrestrial and aquatic organisms and populations. Recommendations of the Advisory

Group were that because of the abundance of reviews and methodologies for dose calculations for aquatic biota, with a few revisions, the section on aquatic biota would be complete. For the section on terrestrial biota, the Advisory Group recommended that the literature review include results of laboratory and domestic animal studies and that the dosimetry calculations be reviewed by other experts in the field. The Scientific Secretary concluded that the document would not be completed for at least one year because of the time required to complete the review on terrestrial biota.

53243 (ORNL/M–836) **Environmental surveillance data report for the first quarter of 1989.** Daniels, K.L.; Goldberg, P.Y.; Horwedel, B..; McCollough, I.L.; Osborne-Lee, A.E.; Tardiff, M.F.; Teeters, S.W.; Valentine, C.K.; Wear, C.J.; Wolf, D.A. Oak Ridge National Lab., TN (USA). Sep 1989. 134p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90001275. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

During the first quarter of 1989, over 4100 samples, which represent more than 9100 analyses and measurements, were collected by the Environmental Monitoring and Compliance Section. A network of real-time monitoring stations that telemeter 10-min averaged readings of radiation levels, total precipitation, flows, water quality parameters, and air quality parameters around Oak Ridge National Laboratory (ORNL) also reported data. In addition, three meteorological towers sent weather data at various heights to a host computer every 15 min. The environmental monitoring program at ORNL was reviewed during this quarter and revisions are currently being implemented to reflect changing requirements and historical results.

53244 (ORNL/RASA–89/4) **Preliminary site survey report for the former Elza Gate warehouse area, Oak Ridge, Tennessee.** Cottrell, W.D.; Quillen, J.L.; Carrier, R.F. Oak Ridge National Lab., TN (USA). Sep 1989. 27p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE90001246. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In the early 1940s, the operations of the Manhattan Engineer District (MED) in support of the war effort included the importation and refining of foreign uranium ore. The radium-bearing sludges that resulted from the refining process were stored in warehouses in Oak Ridge, Tennessee, while awaiting further disposition. Later on, other radioactive materials such as tailings, oxide residues, and slag were also stored in the five warehouses. Following the removal of the stored materials to other facilities, the Atomic Energy Commission's Y-12 Plant in Oak Ridge used the warehouses for a period of time before the site was decontaminated and released for unrestricted use under criteria current at that time. However, because guidelines for use of such sites have become more stringent since previous cleanups, and because it is the policy of DOE to verify that such sites are in compliance with current guidelines, a radiological survey was conducted on parcels 1–4 of the property by members of the Measurement Applications and Development Group of Oak Ridge National Laboratory in March 1989. Survey results show that widespread residual radioactivity from former operations remains on the property, primarily in outdoor soil and as surface contamination on three of the original concrete pads, one of which is inside the present building. Residuals are in excess of the DOE's criteria for cleanup under the Formerly Utilized Sites Remedial Action Program. Since results also indicate that spillover contamination to parcels 5–9 on the property is probable, further surveying of these areas may be appropriate. 4 refs., 7 figs., 9 tabs.

53245 (PB–89-209274/XAB) **Site characterization for radon source potential.** Yokel, F.Y. National Inst. of Standards and Technology (NEL), Gaithersburg, MD (USA). Center for Building Technology. Jun 1989. 59p. (NISTIR–89/4106). Available from NTIS, PC A04/MF A01.

Radon-source potential characterization of sites in terms of soil index properties which do not vary with transient conditions such as moisture content, barometric pressure, temperature and wind speed is studied. The invariant index properties which were found to be critical for site characterization are radium activity concentration in the soil, in-place dry density, porosity, and dry gas permeability. These properties can be measured in-situ or in the laboratory or estimated on the basis of other soil index properties such as grain-size distribution and Atterberg limits. Various expressions for radon source potential are reviewed and a new expression is formulated on the basis of data from areas of deep glacial terrace deposits. Site exploration methods proposed include use of the Standard Penetration Test together with a laboratory determination of radium activity concentration, and a rapid field measurement procedure using a portable gamma-ray spectrometer, a portable nuclear moisture-density meter and retrieval of a soil sample for laboratory determination of particle-size distribution. A plan to develop exploration protocols, test the effectiveness of the source potential prediction, and prepare a draft exploration standard is proposed.

5104 Thermal Effluents Monitoring and Transport

Refer also to citation(s) 52289, 53150

5105 Site Resource and Use Studies

53246 (EGG-CEMA–8510) **Soil classification of proposed NPR [New Production Reactor] sites at the Idaho National Engineering Laboratory.** Breckenridge, R.P.; McGrath, C.L. EG and G Idaho, Inc., Idaho Falls, ID (USA). Center for Environmental Monitoring and Assessment. May 1989. 46p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. Order Number DE89016215. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Idaho National Engineering Laboratory (INEL) is currently being considered as one of three possible locations for the construction of a New Production Reactor (NPR). Two areas have been selected as possible sites for the NPR on the INEL. Prior to selecting the final NPR site, all sites must be characterized. This report classifies the soils of the two proposed NPR sites on the INEL. Soil scientists conducted this survey to classify the types of soils at the two proposed NPR sites. Prior to this study, no soil survey had ever been conducted which covered the proposed sites. However, soil surveys have been published for the surrounding Jefferson, Bonneville and Power counties. The subject survey compared characteristics of the soil profiles of the proposed sites with profiles that have previously been described elsewhere. In addition to the published surveys, a special soil survey was released for Butte County. However, this report primarily addressed the irrigability of soils in Butte County. Following classification of all major soil series at the sites, aerial photographs were used to help delineate the boundaries of each soil series. After the maps were completed, ground surveys were conducted to verify the mapped units. 4 refs., 2 figs., 7 tabs.

5106 Regulations

Refer also to citation(s) 52048, 52489, 52490, 53213, 53214, 53215

53247 (PB–89-188783/XAB) **Superfund Record of Decision (EPA Region 2): Marathon Battery, NY (second remedial action), September 1988 (re-announced).** Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response. 30 Sep 1988. 343p. (EPA/ROD/R–02-88/064). Available from NTIS, PC A15/MF A01.

RE-ANNOUNCED with different title. See also PB–87-190096.

The Marathon Battery Company (MBC) site, a former battery manufacturing plant, is located in the Village of Cold Spring in Putnam, New York, approximately 40 miles north of New York City. The site operated from 1952 to 1979 producing military and commercial batteries. During this time the site changed ownership several times, finally operating as the MBC from 1969 to 1979. Before 1965, the plant's waste-water treatment system discharged into the Hudson River at the Cold Spring pier via the Cold Spring sewer system, except during periods of overload or system shutdown during which time the process effluent was discharged directly into East Foundry Cove Marsh (EFCM) to the southeast. Between November 1972 and July 1973, a limited cleanup was conducted by MBC and other responsible parties, to remove sediment from parts of Foundry Cove and surrounding areas contaminated with cadmium and nickel in excess of 900 mg/kg. The selected remedial

action for Area II at this site includes: decontamination of the former battery facility; excavation; and offsite disposal.

53248 (PB–89-206031/XAB) **Applications analysis report: HAZCON solidification process, Douglassville, Pennsylvania.** Sawyer, S. Foster Wheeler Enviresponse, Inc., Livingston, NJ (USA). May 1989. 64p. Available from NTIS, PC A04/MF A01.

Also available from Supt. of Docs. See also PB–89-158810.

This document is an evaluation of the HAZCON solidification technology and its applicability as an on-site treatment method for waste-site cleanup. A demonstration was held at the Douglassville, Pennsylvania Superfund site in the fall of 1987. Operational data and sampling and analysis information were carefully monitored and controlled to establish a data base against which other available data and the vendor's claims for the technology could be compared and evaluated. Conclusions were reached concerning the technology's suitability for use in clean up of the types of materials found at the test site, and extrapolations were made to cleanups of other materials.

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

Refer also to citation(s) 53225

53249 (BR–82(11.105)) **Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (North and Mid-Atlantic): Tautog and cunner.** Auster, P.J. Connecticut Univ., Groton, CT (USA). Aug 1989. 14p. Sponsored by U.S. Department of Defense; U.S. Department of the Interior. (TR-EL–82-4/82(11.105)). Available from OSTI - US Fish and Wildlife Service, NASA-Slidell Computer Complex, 1010 Gause Blvd., Slidell, LA 70458.

Species profiles are summaries of literature on the taxonomy, morphology, range, life history, and environmental requirements of coastal finfishes and shellfishes. They are designed to assist in environmental impact assessment. Tautog (*Tautoga onitis*) and cunner (*Tautogolabrus adspersus*) are common coastally distributed species along the northeast US. Both species are active during the day and require shelter sites at night, when they are inactive. They also require overwintering shelter when torpid. Cunner are omnivorous, feeding on a variety of primarily benthic species; tautog feed primarily on mussels (*Mytilus edulis*). Tautog spawn from mid-May to mid-August and cunner from early May to late August. Longevity of cunner, the smaller of the two species, is 6 years and that of tautog, the larger species, is about 34 years. Due to their nocturnal and low-temperature inactivity, these species are unable to avoid short-term detrimental environmental disturbances. Since they undertake no long-distance migrations, they are key indicators of site-specific stress along the coast. 43 refs., 4 figs., 1 tab.

53250 (BR–82(11.106)) **Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic): Rainbow smelt.** Buckley, J. Massachusetts Univ., Amherst, MA (USA). Dept. of Forestry and Wildlife Management. Aug 1989. 12p. Sponsored by U.S. Department of the Interior. (TR-EL–82-4/82(11.106)). Available from OSTI - US Fish and Wildlife Services, NASA-Slidell Computer Complex, 1010 Gause Blvd., Slidell, LA 70458.

Species profiles are literature summaries of the taxonomy, life history, and environmental requirements of coastal fishes and aquatic invertebrates. They are designed to assist with environmental impact assessments. The rainbow smelt is an abundant forage fish for commercially and recreationally valuable fishes such as striped bass and bluefish on the East Coast and several species of salmon and trout in the Great Lakes. The rainbow smelt also supports an important sportfishery throughout most of its range. In 1976, the total smelt harvest in the coastal waters of New England was 105,000 lb. Coastal rainbow smelt are anadromous, spawning in freshwater and maturing in saline water. Spawning peaks in spring. Salinities above 12 ppt were fatal to eggs. Reported fecundities are 7,000 to 44,000 eggs per female. Smelt are always found in shallow water (<6 m deep) and within 2 km of the shore. Larval and juvenile smelt along the coast feed on planktonic crustaceans. Larger juveniles and adults feed on euphausiids, amphipods, on planktonic crustaceans. Larger juveniles and adults feed on euphausiids, amphipods, polychaetes, and fish. Smelt move locally to search for optimum water temperatures. 46 refs., 2 figs., 1 tab.

53251 (BR–82(11.108)) **Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic): Atlantic menhaden.** Rogers, S.G.; Van Den Avyle, M.J. Georgia Univ., Athens, GA (USA). Georgia Cooperative Fishery Research Unit. Aug 1989. 24p. Sponsored by U.S. Department of the Interior. (TR-EL–82-4/82(11.108)). Available from OSTI - US Fish and Wildlife Service, NASA-Slidell Computer Complex, 1010 Gause Blvd., Slidell, LA 70458.

Species profiles are literature summaries of the life history, distribution and environmental requirements of coastal fishes and invertebrates. Profiles are prepared to assist with environmental impact assessment. The Atlantic menhaden (Brevoortia tyrannus) is an important commercial fish along the Atlantic coast. In the South Atlantic Region, Atlantic menhaden spawn during winter in continental shelf waters. Adults then move inshore and northward in spring; some move into estuaries as far as the brackish-freshwater boundary. Atlantic menhaden larvae in the South Atlantic Region enter estuaries after 1 to 3 months at sea. Young fish move into the shallow regions of estuaries and seem to prefer vegetated marsh habitats. Atlantic menhaden are size-selective plankton feeders as larvae, and filter feeders as juveniles and adults. Due to their large population size, individual growth rates, and seasonal movements, Atlantic menhaden annually consume and redistribute large amounts of energy and materials. They are also important prey for large game fishes such as bluefish (Pomatomus saltatrix), striped bass (Morone saxatilis), and bluefin tuna (Thunnus thynnus). The Atlantic menhaden is associated with estuarine and nearshore systems during all phases of its life cycle. Young menhaden require these food-rich habitats to survive and grown. Destruction of estuarine wetlands has decreased nursery habitat available to Atlantic menhaden and other estuarine wetlands has decreased nursery habitat available to Atlantic menhaden and other estuarine-dependent species. 115 refs., 2 figs., 2 tabs.

53252 (BR–82(11.109)) **Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic): Weakfish.** Mercer, L.P. Army Engineer Waterways Experiment Station, Vicksburg, MS (USA); National Wetlands Research Center, Slidell, LA (USA); North Carolina Div. of Marine Fisheries, Morehead City, NC (USA). Aug 1989. 17p. Sponsored by U.S. Department of the Interior. (TR-EL–82-4/82(11.109)). Available from OSTI; US Fish and Wildlife Service, NASA-Slidell Computer Complex, 1010 Gause Blvd., Slidell, LA 70458.

Species profiles are literature summaries of the taxonomy, morphology, range, life, history, and environmental requirements of coastal aquatic species. They are designed to assist in environmental impact assessment. Weakfish are one of the most abundant fishes in the estuarine and nearshore waters of the Atlantic coast. Weakfish mature at age I throughout their range and spawning takes place in coastal and estuarine waters from March to September. Juveniles utilize the deeper areas within estuarine as nursery grounds, migrate from high to low salinity areas throughout the summer, return to high salinity areas in fall, and most leave the estuaries by late fall. Some may remain in estuarine and nearshore coastal waters in winter, particularly in southern areas. Adult weakfish migrate seasonally, north in spring and south in fall between inshore and offshore waters. Growth rates, maximum size, and longevity of weakfish are higher at the northern end of the range. Weakfish are an important recreational and commercial species in the Mid-Atlantic. Weakfish feed predominately on mysid shrimp and anchovies as juveniles, and on clupeids and anchovies as adults. Weakfish have been found over a temperature range of 9.5 to 30.8 °C. Juvenile weakfish have been found over a wider salinity range (0.1–31.7 ppt) than adults (6.6–32.3 ppt). 72 refs., 5 figs., 5 tabs.

53253 (BR–82(11.110)) **Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (south Florida): Black, red, and Nassau groupers.** Jory, D.E.; Iversen, E.S. Army Engineer Waterways Experiment Station, Vicksburg, MS (USA); National Wetlands Research Center, Slidell, LA

(USA); Miami Univ., FL (USA). Rosenstiel School of Marine and Atmospheric Sciences. Aug 1989. 21p. Sponsored by U.S. Department of the Interior. (TR-EL-82-4/82(11.110)). Available from OSTI; US Fish and Wildlife Service, NASA-Slidell Computer Complex, 1010 Gause Blvd., Slidell, LA 70458.

Black, red, and Nassau groupers (Mycteroperca bonaci, Epinephelus morio, and E. striatus, respectively) are widely distributed on rocky bottoms and reefs along the south Florida coast. They are the most valuable marine finfish group in Florida, comprising about 25% of the total value of landings in 1984. The three species can be distinguished by morphometric, meristic, and body color characteristics. Younger fish are typically found in shallow, inshore grass beds, and larger, older fish are generally restricted to deep waters. The three species are protogynous hermaphrodites. Sexual transition can occur at any length over about 300 mm SL. An offshore movement apparently coincides with the onset of sexual maturity. Spawning aggregations have been observed throughout the year, but occur mostly between late spring and early summer. Fecundity estimates range from about 800,000 to 5,000,000 eggs per female. Both the eggs and the larvae are planktonic. Their early life history is poorly known. Larvae probably leave the plankton and become benthic at around 20–30 mm SL. Growth rates range from about 2 to 10 mm/month. The three species are unspecialized carnivores, feeding on a variety of fishes, crustaceans, and mollusks. Interspecific competition for food and shelter may be common because of the overlap in distribution, habitat, size, and food habitats. For the three species, a number of predators and parasites have been reported. Both the black and red groupers have been implicated in ciguatera poisonings in south Florida. 70 refs., 3 figs., 3 tabs.

53254 (BR-82-(11.112)) **Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic): Summer and winter flounder.** Grimes, B.H.; Huish, M.T.; Kerby, J.H.; Moran, D. Fish and Wildlife Service, Raleigh, NC (USA). North Carolina Cooperative Wildlife and Fishery and Research Unit; National Wetlands Research Center, Slidell, LA (USA). Aug 1989. 19p. Sponsored by U.S. Department of Defense; U.S. Department of the Interior. (TR-EL-82-4/82(11.112)). Available from OSTI - US Fish and Wildlife Service, NASA-Slidell Computer Complex, 1010 Gause Boulevard, Slidell, LA 70458.

Species profiles are literature summaries of the taxonomy, morphology, range, life history, and environmental requirements of coastal species. They are designed to assist in environmental impact assessments. The summer flounder supports an important commercial and recreational fishery in the Mid-Atlantic and are important constituent of estuarine and continental shelf systems throughout the region. Summer flounder spawning begins in September and winter flounder spawning begins in June. Summer flounder eggs are pelagic whereas winter flounder eggs are demersal. Summer flounder larvae are more abundant in inlets, and juveniles are found in estuarine seagrass beds in salinities { >=} 12 ppt. Winter flounder juveniles are abundant in shallow bays and estuaries, moving seaward in spring and summer. Growth of winter flounder and summer flounder is seasonal. There are probably three spawning populations of both species which produce a complex stock pattern. Summer flounder are tolerant of a wide range of chemical and physica faactors, but prefer >10 ppt salinities. Winter flounder optimal temperature is 18.5 °C. Diseases of winter flounder are more prevalent in polluted waters. Summer flounder are tolerant of sediments laden with contaminants. 64 refs., 5 figs., 2 tabs.

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Refer also to citation(s) 51860, 52499, 52500, 52757, 53154, 53165

53255 (AD-A-208915/9/XAB) **Theoretical models for evaluation of volatile emissions to air during dredged-material disposal with applications to New Bedford Harbor, Massachusetts. Final report, July 1987-June 1988.** Thibodeaux, L.J. Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Environmental Lab. May 1989. 58p. (WES/MP/EL-89-3). Available from NTIS, PC A04/MF A01.

Some bottom sediments in both fresh and marine waters are contaminated with hazardous organic chemicals that are classified as volatile and semivolatile. An example is the New Bedford Harbor and Acushnet River Estuary sediment, which contains quantities of the polychlorinated biphenyls Aroclors 1242, 1248, and 1254. Dredged material contaminated with these and other volatile organic chemicals (VOCs) can release these contaminants to the atmosphere during and after disposal by volatilization. Methods to predict these volatilization losses are needed to develop design, operation, and management guidelines for controlling VOC emissions. Volatilization rates for hydrophobic organic compounds from a confined disposal facility (CDF) containing contaminated dredged material are presently unknown. The primary purpose of this study was to assess the availability of theoretical models for the evaluation of volatile emissions to air during the process of dredged-material disposal in a CDF. The first objective was to identify the primary vapor phase transport mechanism for various CDF designs and stages of filling. This provided the theoretical basis for assessing relative volatilization rates. The second objective was to review available laboratory and field procedures for obtaining the information needed to measure volatile losses. The report also contains preliminary calculations of the emission rates of Aroclors 1242 and 1254 from a hypothetical CDF operation in the Upper Acushnet River Estuary (Appendix A). Appendix B presents a detailed derivation of the rivulet and ponded VOC emission model.

53256 (CONF-891042-2) **Characterization of the ORNL [Oak Ridge National Laboratory] Biology Area process wastewater.** Armento, W.J.; Stephens, L.A.; Haught, C.F.; Blaise, D.E. Oak Ridge National Lab., TN (USA). 1989. 27p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 31. ORNL/DOE conference on analytical chemistry in energy technology; Gatlinburg, TN (USA); 10-12 Oct 1989. Order Number DE90001333. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In order for proper treatment of the Biology Area process wastewater to be affected and that a Federal Facilities Compliance Agreement (FFCA) be met at the Y-12 Plant, both flow rates and potential wastewater-contained pollutants were measured. A two-phase sampling-and-analysis program determined that the only detrimental constituent in the wastewater is residual chlorine. In addition, flow-rate measurements indicated that the Biology Area discharge rates were decreasing with time as the Biology Division implemented a strict schedule for reducing its effluent flow rates and total pollutant loadings. As a result, the capital costs and potential annual operating costs were greatly reduced (by as much as $1 million and $750,000, respectively) by demonstrating that the Biology Area process wastewater could be sent to the City of Oak Ridge Wastewater Treatment Facility. A special treatment plant, to be built at the Y-12 Plant, would not be needed. Because of the presence of residual chlorine in the wastewater, the fragility of the wastewater solutions was tested over periods of 1 or 2 d to determine the best method of preserving the samples so that loss of the residual chlorine would be minimized. Refrigeration of the samples for as long as 8 h was found to be satisfactory; loss of residual chlorine in the wastewater was almost undetectable under these conditions. 17 figs., 3 tabs.

53257 (DOE/BC/14304-T4) **The Louisiana Department of Natural Resources, Office of Conservation, Injection and Mining Division underground injection control program: A peer review.** Underground Injection Practices Council, Oklahoma City, OK (USA). 1989. 132p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-89BC14304. Order Number DE90001544. Available from NTIS, PC A07/MF A01 - OSTI.

The reports included herein and any reports added subsequently are the result of an effort to evaluate the effectiveness of state programs to protect Underground Sources of Drinking Water (USDW) from potential contamination resulting from the operation of injection wells related to the production of oil and gas (Class II injection wells). A USDW is defined as an aquifer or its portion which supplies a public water system, or which contains sufficient water to supply a public water system, and currently supplies drinking water for human consumption, or contains a concentration of less than 10,000 mg/l total dissolved solids (TDS) and which is not otherwise exempted as a USDW. Where defined waters other than USDWs exist and where they are addressed in the state program, they are

highlighted in the General Program Comments and Observations portion of the report. Readers will need to exercise care when using individual state reports to understand specific relationships between USDWs and any waters with a more limited definition. The Review Team's conclusions are in every case based on protection of USDWs. The programs examined in this study cover wells which are used for the injection of fluids into oil reservoirs for the purpose of stimulating or furthering their production when natural production mechanisms decline or cease (enhanced recovery wells) and for the disposal of waters produced in conjunction with the production of oil and gas (disposal wells).

53258 (GKSS–89/E/15) **X-ray diffraction and chemical examination of suspended particulates from the Elbe river.** Koopmann, C. GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); Hamburg Univ. (Germany, F.R.). Fachbereich Geowissenschaften. 1989. 103p. (In German). Order Number DE90711709. Available from NTIS (US Sales Only), PC A06/MF A01.

The behaviour of suspended matter and trace elements in an estuary depends on the individual conditions and is strongly influenced by the complex hydrodynamic processes. These processes are characterized by spatial and temporal variations. In order to quantify the variability in the Elbe estuary two experiments were carried out in the lower section of the Elbe (summer 1985, spring 1986). Water samples were taken at three anchor stations in three water depths during four characteristic tidal phases. The composition of the suspended matter was determined and a qualitative and quantitative mineral analysis was carried out. A difference was made between dissolved and particulate forms of trace elements. Particulate trace element and organic carbon contents were determined both in unfractionated and fractionated suspended matter samples. The results gave evidence for different binding sites of the elements. The experiments covered two extreme situations, which reflect an essential part of the natural variations of the estuarine hydrodynamics and by this a considerable portion of the mineralogical, chemical and hydrographic parameter varations. (orig.) With 42 figs, 18 tabs.

53259 (ORNL/FTR–2498) **[Man-made radionuclides as tracers for biogeochemical and limnological processes]: Foreign trip report, February 4–24, 1987.** Olsen, C.R. Oak Ridge National Lab., TN (USA). 9 Mar 1987. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89017355. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

C.R. Olsen attended the 23rd SIL Congress and was asked to chair a session on man-made radionuclides as tracers for biogeochemical and limnological processes at the next Congress in Munich in 1989. The traveler presented his results on the use of radionuclides to quantify contaminant sorption kinetics and water-column removal rates at the IASW Symposium. Numerous discussions with several European scientists provided valuable information concerning the environmental fate of radionuclides released during the recent accident at Chernobyl. The traveler developed contacts with Swedish scientists involved in quantifying the effects of sediment resuspension on nutrient cycles. At the University of Melbourne, scientists have developed a new nuclear technique for reconstructing paleotemperatures and aiding in oil exploration.

53260 (PB–89-197156/XAB) **In-situ bioreclamation of contaminated ground water.** Rittmann, B.E.; Valocchi, A.J.; Odencrantz, J.E.; Bae, W. Illinois Univ., Urbana, IL (USA). Dept. of Civil Engineering. Nov 1988. 137p. Available from NTIS, PC A07/MF A01.

The report summarizes the results of a research project aimed at developing a better mechanistic understanding of the phenomena controlling in situ biological activity. A methodology involving laboratory-column experiments and computer modeling was utilized to investigate the formation of biologically active zones (BAZs) when a limiting electron acceptor (NO_3^-) is injected along the flow path and the secondary utilization of trace-level pollutants contained in the water flowing through the BAZ.

53261 (PB–89-197453/XAB) **Economics of sample compositing as a screening tool in ground-water-quality monitoring.** Rajagopal, R.; Williams, L.R. Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring Systems Lab. 1989. 10p. (EPA–600/J-89/044). Available from NTIS, PC A02/MF A01.

Pub. in GWMR, 186-192(1989).

Recent advances in high throughput/automated compositing with robotics/field-screening methods offer seldom-tapped opportunities for achieving cost reduction in ground-water-quality monitoring programs. An economic framework is presented for the evaluation of sample compositing as a screening tool in ground-water-quality monitoring. When the likelihood of occurrence of a contaminant in a well is very small, the use of sample compositing instead of routine exhaustive sampling will lead to reduction in analytical efforts. Such reduction will be maximum when there are no contaminated wells in the network. An N-fold reduction will result when none of the wells in a network of N wells are contaminated. When 25% or more wells in a network are contaminated, the use of sample compositing will require, at the most, an additional 50% analytical effort compared to exhaustive sampling. A quantitative ratio (fl) of laboratory analytical cost to that of well installation and field sampling costs and a ratio (f2) of the expected number of contaminated wells to that of the total number of wells were determined. Several useful mathematical results of primary interest are derived and illustrated with case examples in the paper. Selected areas for further research are also outlined.

53262 (PB–89-198246/XAB) **Direct/Delayed Response Project: Definition of soil-sampling classes and selection of sampling sites for the Northeast.** Lee, J.J.; Marmorek, D.R.; Thornton, K.W.; Stevens, D.L.; Lammers, D.A. Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab. Apr 1989. 107p. (EPA–600/3-89/041). Available from NTIS, PC A06/MF A01.

The Direct/Delayed Response Project (DDRP) was designed and implemented to estimate the number of lakes and streams that might become acidic in three regions due to current or altered levels of acidic deposition. As part of DDRP, 145 watersheds in the northeast US were mapped at 1:24,000 for soils, vegetation, depth to bedrock, and bedrock geology. About 600 soils were identified during mapping. These were grouped into 38 soil-sampling classes. Each of these was sampled about 8 times across the region, so that regional means and standard deviations of soil properties could be computed for each class. The regional soil data will be used with the soil maps to estimate soil properties for each watershed. The watershed estimates will be used in the array of DDRP models to estimate future effects of acidic deposition on lakes in the northeast. The sampling classes were developed at a workshop held in Corvallis, Oregon July 16-18, 1985. This report documents the process and decisions of the workshop.

53263 (PB–89-204432/XAB) **North Carolina sanitary landfills: Leachate generation, management, and water-quality impacts.** Borden, R.C.; Yanoschak, T.M. North Carolina Water Resources Research Inst., Raleigh, NC (USA). Mar 1989. 66p. (UNC-WRRI–89-243). Available from NTIS, PC A04/MF A01.

The most widely used method of solid-waste disposal in North Carolina is burial in unlined municipally operated sanitary landfills (SLFs). A statistical analysis of existing surface- and ground-water monitoring data from 71 municipal sanitary landfills was performed to assess the impact of North Carolina SLFs on surface- and ground-water quality. A total of 322 surface and 411 ground-water quality records was analyzed using the SAS data system. Almost all the landfill records included inorganic and heavy-metal analyses, while approximately half of the records also include organic scans by GC/MS. Ground-water quality violations were detected for organic or inorganic pollutants at 53% of the landfills examined with adequate monitoring data. The severity of ground-water contamination at SLFs appears to be highly variable. At many of the landfills with ground-water quality problems, a 50% reduction in pollutant concentration would eliminate all violations. At a few isolated landfills, extremely high concentration of organic and inorganic pollutants has been detected. At these landfills, greater than 99.99% reductions would be required to meet existing standards. The results suggests that: most landfills do contaminate groundwater; the severity of contamination is highly variable; and the existing monitoring program is reasonably effective at detecting widespread trends.

53264 (PB–89-204440/XAB) **Distribution and mobilization of arsenic and antimony species in the Coeur d'Alene River system. Research report (Technical).** Wai, C.M.; Mok, W.M. Idaho Univ., Moscow, ID (USA). Water Resources Research Inst. May 1989. 64p. Available from NTIS, PC A04/MF A01.

The mining industry along the South Fork of the Coeur d'Alene River in northern Idaho is a major producer of silver, lead, and zinc in the United States. Mining operations in the past have discharged huge amounts of mining wastes into the South Fork of the river causing a serious pollution problem for the Coeur d'Alene River system. Sediments in the South Fork and the main stem of the river are contaminated with arsenic(As), antimony(Sb), cadmium(Cd), lead(Pb), zinc(Zn), and other metals. Leaching of As and Sb from the sediments along the main stem depends on the pH of the water and on the iron and manganese content of the sediments. The releases of As and Sb from the sediments appear to associate with the free iron oxides and manganese oxides in the sediments. However, releases of sediment Sb were generally found linear with respect to time while asymptotic limits on As releases were reached. Significant amounts of Zn, Fe, and Mn were also released during leaching, but Cu, Cd, Pb, and Ni were much less leachable. According to the study, interaction of water with the existing sediments is likely to be a major factor controlling the water quality of the Coeur d'Alene River.

53265 (PB–89-206767/XAB) **Evaluation of candidate measures of biological effects for the National Status and Trends Program. Technical memo. February 1987-April 1989 (Final).** Long, E.R.; Buchman, M.F. National Ocean Service, Rockville, MD (USA). Office of Oceanography and Marine Assessment. Apr 1989. 187p. (NOAA/TM/NOS/OMA–45). Available from NTIS, PC A09/MF A01.

Errata sheet inserted.

An evaluation of candidate measures of biological effects to a range in contaminant concentrations was performed in the San Francisco Bay area in 1987. The evaluation was performed to determine which of the candidate measures may be useful in the National Status and Trends (NS&T) Program. The evaluation included biological tests of sediments and fish. It was presumed that the biological tests most applicable to the NS&T Program would be those that were able to indicate differences among sampling locations over a range in chemical contamination and/or between sampling locations and laboratory controls, that had relatively large ranges in response among mean values for the sampling locations, that presented relatively small analytical errors, and that indicated patterns in biological response that generally paralleled the pattern in chemical contamination.

53266 (PB–89-207351/XAB) **Comparison of methods to determine oxygen demand for bioremediation of a fuel-contaminated aquifer.** Powell, R.M.; Callaway, R.W.; Michalowski, J.T.; Vandegrift, S.A.; White, M.V. Northrop Services, Inc./Environmental Sciences, Ada, OK (USA). 1988. 13p. Available from NTIS, PC A03/MF A01.

Pub. in International Jnl. of Environmental Analytical Chemistry, Vol. 34, No. 3, 253-263(Sep 1988).

Four analytical methods were compared for estimating concentrations of fuel contaminants in subsurface core samples. The methods were total organic carbon, chemical oxygen demand, oil and grease, and a solvent extraction of fuel hydrocarbons combined with a gas chromatographic technique. Presently the most applicable and convenient technique, based on greatest apparent contaminant recovery, is the solvent-extraction gas-chromatographic method. Sample heterogeneity and opportunity for losses due to contaminant volatility require considerations during sample handling, analysis, and when interpreting analytical data.

53267 (PB–89-208912/XAB) **Scheme for the direct analysis of organics in the environment by tandem mass spectrometry.** Hunt, D.F.; Shabanowitz, J.; Harvey, T.M.; Coates, M. Virginia Univ., Charlottesville, VA (USA). Dept. of Chemistry. 1985. 15p. Available from NTIS, PC A03/MF A01.

Pub. in Analytical Chemistry, Vol. 57, No. 2, 525-537(Feb 1985).

Direct analysis of hazardous organic chemicals in the environment by tandem mass spectrometry is described. Liquid and solid chemical wastes and residues from lyophilized aqueous solutions are volatilized directly into the ion source of a triple quadrupole instrument. All or most wet chemical and chromatographic separation steps are eliminated. Analysis of phthalates, aromatic hydrocarbons, chlorocarbons, phenols, amines, and carboxylic acids by functional group and molecular weight is accomplished by using the technique of collision-activated dissociation and a series of 0.5-s neutral loss and parent ion scans under data system control on a triple quadrupole instrument. Both knowns and unknowns are characterized, detection limits are at the 10-100 ppb level, and the total analysis time per sample is typically only 25-30 min.

53268 (PB–89-214985/XAB) **Quality-assurance data for routine water analysis in the National Water-Quality Laboratory of the US Geological Survey for water year 1987. Water-Resources Investigation.** Lucey, K.J.; Peart, D.B. Geological Survey, Denver, CO (USA). Water Resources Div. 1989. 98p. (USGS/WRIR–89-4049). Available from NTIS, PC A05/MF A01.

Also available from Supt. of Docs.

The U.S. Geological Survey maintains a quality-assurance program based on the analysis of reference samples for its National Water-Quality Laboratory located in Denver, Colorado. Reference samples containing selected inorganic constituents are prepared at the Survey's Water Quality Services Unit in Ocala, Florida, disguised as routine samples, and sent daily or weekly, as appropriate, to the laboratory through other Survey offices. Nutrient samples and precipitation samples also were submitted as samples of unknown concentration. The results are stored permanently in the National Water Data Storage and Retrieval System (WATSTORE), the Survey's data base for all water data. These data are analyzed statistically for precision and bias. The results of these statistical analyses are discussed for data collected during water-year 1987.

53269 (PB–89-215412/XAB) **Needs survey report to Congress: 1988 assessment of needed publicly owned wastewater treatment facilities in the United States. Data file.** Hudson, J.; Cooper, R.; Czado, T. Environmental Protection Agency, Washington, DC (USA). Municipal Facilities Div. 1 Jan 1988. mag ta Available from NTISCP T03.

See also PB–85-172690. Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. For price at 6250 bpi density, call NTIS Computer Products. Price includes documentation, PB–89-189633.

The data tape includes cost estimates for waste-water treatment facilities and State supplied technical data. These data were used to produce the 1988 Needs Survey Report to Congress. The data on the tape were collected through 'IHS', in-house software where States perform direct on-line data updates.

53270 (PB–89-217962/XAB) **Coeur d'Alene basin EPA (Environmental Protection Agency) water quality monitoring, 1972-1986.** Hornig, C.E.; Terpening, D.A.; Bogue, M.W. Environmental Protection Agency, Seattle, WA (USA). Sep 1988. 40p. (EPA–910/9-88/216). Available from NTIS, PC A03/MF A01.

See also PB–86-153640.

Region 10, U.S. EPA, has conducted chemical and biological monitoring during low-flow conditions from 1972 to 1986 along the South Fork Coeur d'Alene River in northern Idaho, a stream with a long history of severe metals pollution from mining activities. During 1986, metals analysis of sediments and tissues from the lower Coeur d'Alene River and Coeur d'Alene Lake was also conducted. Due chiefly to effluent controls at the Bunker Hill Complex Superfund site, concentrations of zinc, cadmium, and lead were reduced since the 1970's. Although levels of zinc and cadmium remain well above national criteria for protection of cold water biota, recovery of aquatic life has been substantial, with the lower mainstream now supporting a successful sports fishery. Sediments in the lower Coeur d'Alene system remain heavily contaminated with toxic metals, although high levels in edible fish tissues were not found. Allowable permit limits (as of 1986) for metals (primarily cadmium) have the potential of increasing in-stream metals concentrations. Water quality-based permits are particularly important for aquatic life protection of the South Fork upstream of Mullan and the mainstream downstream of the S.F. confluence.

53271 (PB–89-867295/XAB) **Waste-water treatment: Ozonation processes and equipment. January 1977-July 1989 (Citations from the Selected Water Resources Abstracts data base). Report for January 1977-July 1989.** National Technical Information Service, Springfield, VA (USA). Aug 1989. 158p. Available from NTISPC N01/MF N01.

Supersedes PB–88-867122.

This bibliography contains citations concerning the utilization of ozonation processes for waste-water disinfection. Topics include system descriptions and evaluations, comparisons with the chlorination process, reaction kinetics, and the use of the process in combination with other waste-water treatment methods. The treatment of organic and inorganic compounds in waste-water and municipal-water supplies is discussed. (This updated bibliography contains 292 citations, 37 of which are new entries to the previous edition.)

53272 (PB–89-867477/XAB) **Activated-sludge process: Waste treatment. January 1985-July 1989 (Citations from the Biobusiness data base). Report for January 1985-July 1989.** National Technical Information Service, Springfield, VA (USA). Aug 1989. 76p. Available from NTISPC N01/MF N01.

This bibliography contains citations concerning the use of the activated sludge process in waste and waste-water treatment. Biochemistry of the activated sludge process, the effects of various pollutants on process activity, effects of environmental variables such as oxygen and water levels, nutrient requirements of microorganisms employed in activated-sludge processes, and the application of the process to specific wastes such as pharmaceuticals, halocarbons, metallic wastes, dairy wastes, coke-plant waste waters, and petrochemical effluents are among the topics discussed. Operating experiences at large plants are included. (Contains 154 citations fully indexed and including a title list.)

53273 (PNL-SA–16636) **Amphipod bioassay of selected sediments from Sequim Bay, Washington.** Ramsdell, K.A.; Strand, J.A.; Cullinan, V. I. Pacific Northwest Lab., Richland, WA (USA). Jun 1989. 24p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-76RL01830. (CONF-8909128–2: Oceans '89 conference, Seattle, WA (USA), 18-21 Sep 1989). Order Number DE90001390. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Amphipod bioassays performed during reconnaissance surveys of Sequim Bay in 1983–1984 for the US Environmental Protection Agency suggested possible sediment toxicity at three sites. These findings were not supported by other biological analyses and tests (dominant infauna, oyster larvae test) nor by the finding of relatively low levels of priority pollutants. In 1988, a re-examination of the 1983–1984 sites demonstrated that the Sequim Bay sediments were clearly nontoxic. Mean survivorship ranged from 89 to 100%. It was hypothesized that earlier indications of toxicity may have been due to a relatively high percentage of fines ($\geq$80%) and/or a relatively low interstitial salinity (24%) encountered at one or more of the 1983–1984 sites. The continued use of Sequim Bay as both a reference bay and a source of control sediment in future marine research is recommended. 13 refs., 5 figs., 3 tabs.

5203 Radioactive Materials Monitoring and Transport

Refer also to citation(s) 51827, 51869, 52281, 52308, 52311, 53233, 53238, 53242, 53243

53274 (AERE-R–13393) **Interlaboratory study of sampling and characterisation techniques for groundwater colloids.** Longworth, G.; Ivanovich, M.; Ross, C.A.M.; Degueldre, C. UKAEA Harwell Lab. (UK). Nuclear Physics and Instrumentation Div. Feb 1989. 27p. Available from H.M. Stationery Office, London, price Pound 10.00.

Natural colloids may be important in the transport of radionuclides in groundwater and could significantly affect any analysis of repository safety. This report presents the results of an intercomparison exercise on techniques for sampling and characterisation of natural groundwater colloids. In this study a comparison was made of colloid populations, composition and size distributions in colloid concentrate samples taken in the field, of a poorly mineralised groundwater abstracted from fractured Permo-Triassic sandstone in the English East Midlands. A comparison was made of two methods; pulsed cross-flow ultrafiltration and tangential flow ultrafiltration. The actinide isotopic activities associated with the colloids were also determined, using isotope dilution/alpha spectrometry, at Harwell. The results from this intercomparison exercise indicate that: (i) no artefacts are produced by either colloid concentration method, although some aggregation of colloidal particles may occur on storage of aqueous colloid concentrates, (ii) good agreement on colloid populations and size distributions is obtained by different laboratories applying scanning electron microscopic analysis to cross-flow ultrafilters and (iii) no evidence was found for a significant change in colloid concentration or actinide loading after the groundwater had been stored in platinised aluminium barrels for $\sim$ 6 months. (author).

53275 (ENEA-RT-PAS–85-19) **Low levels of tritium and trace elements in autopsy tissue: Analytical methods.** Belloni, P.; Clemente, G.F.; Di Pietro, S.; Ingrao, G. ENEA, Casaccia (Italy). Dipt. Protezione Ambientale e Salute dell'Uomo. Feb 1985. 18p. (In Italian). Order Number DE89761996. Available from NTIS (US Sales Only), PC A03/MF A01.

Measurements of the equilibrium environmental tritium levels in the various components of the ecosystem are necessary to formulate realistic models for the physical dispersion and the ecological behavior of tritium following a release into the environment. Average tritium levels in environmental samples (air, rain, snow, surface water) in diets and biological samples (urine, blood) are reported in this paper. Preliminary data on tritium levels in human tissues are also given.

53276 (IPPJ-REV–3, pp. 32-38) **Tritium concentrations in natural waters in Japan before use of a large quantity of tritium on its fusion program.** Kaji, Toshio (Kyushu Univ., Fukuoka (Japan). Radioisotope Center); Momoshima, Noriyuki; Takashima, Yoshimasa. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

To clarify environmental tritium levels in Japan before use of a large quantity of tritium on its fusion program, the authors analyzed the tritium concentrations in various water samples, such as rain, river, lake, coastal sea and deep sea waters in Japan. The tritium concentrations in rain water were high at higher latitude. The definite differences of the tritium concentrations due to the weather conditions or seasons were not observed. The average tritium concentration in river water was 51.5 pCi/l in 1982 and that in lake water was 63.5 pCi/l in 1983. The vertical profiles of the tritium concentrations in the representative lakes were almost homogeneous except surface water. The average tritium concentrations in coastal seawater were about 20 pCi/l in both 1982 and 1983. The tendency of the increased tritium level with latitude as reported in literature was not observed by these experiments. Tritium levels in natural water in small isolated islands were lower than those at other places. In the Japan Sea, it was recognized that tritium was distributed down to around 2000 m in depth. This means that the more active vertical mixing of water masses than that in the Pacific Ocean is taking place. (author).

53277 (PB–89-198097/XAB) **Biogeochemistry of (210)Pb and (210)Po in fresh waters and sediments. Doctoral thesis.** Benoit, G. Woods Hole Oceanographic Institution, MA (USA). Jun 1988. 299p. (WHOI–88-26). Available from NTIS, PC A13/MF A01.

The geochemical cycling of (210)Pb in a Massachusetts lake was studied. A mass balance for the epilimnion showed that (210)Pb inputs by precipitation were matched by outputs on settling particles, so direct uptake by bottom sediments was inconsequential. Below the epilimnion, vertical mixing was very low because of a steep temperature/density gradient, and this limited vertical transport. Anoxic conditions caused remobilization of iron and (210)Pb, which reprecipitated at the oxycline and returned to the bottom via settling. Below the zone of precipitation, (210)Pb and iron distributions resulted from constant release from anoxic sediments and dilution in

the water column. Sediment (210)Pb distributions were caused by sedimentation and Fickian transport. The Fickian component was equal to the pore water diffusive flux. In pore waters, (210)Pb and (210)Po were 100 times greater that in overlying water and had steep concentration gradients, unlike Fe, Mn, S(-II), and alkalinity. (210)Pb partition coefficients decreased from 15000 to 1500 with depth controlled by sorption on iron oxides. Remobilization to the water column comes from a thin layer of iron-rich floc near the sediment/water interface. Deeper in the cores, diffusive transport can cause redistribution of (210)Pb to an extent that can affect (210)Pb dating.

53278 (PB–89-203913/XAB) **Cesium and strontium isotopes in the northwestern North Atlantic and Arctic Ocean, 1981-1985. Technical report.** Casso, S.A.; Clarke, W.R.; Livingston, H.D.; Palmieri, J.M.; Surprenant, L.D. Woods Hole Oceanographic Institution, MA (USA). Apr 1988. 53p. (WHOI–88-8). Available from NTIS, PC A04/MF A01.

The report contains (137)Cs and (90)Sr data from seawater samples collected on four cruises in the northwestern North Atlantic, Arctic Ocean, and Barents Sea during 1981 to 1985, and radionuclide data (137)Cs, (90)Sr and (239)Pu from samples collected on a cruise to the Norwegian-Greenland Seas in 1979. Also included are data from four ice stations in the Arctic from 1979 to 1985. The sample collections were made possible through collaborative efforts with several laboratories. The radionuclide analyses were done at the Woods Hole Oceanographic Institution.

5204 Thermal Effluents Monitoring and Transport

Refer also to citation(s) 52276

53279 (CEGB-RD/L–3303/R88) **Status of projects using reject heat for aquaculture and horticulture at power plants in the EEC.** Aston, R.J. Central Electricity Research Labs., Leatherhead (UK). Aug 1988. 24p. Order Number DE90606539. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Data collected mainly from an inventory of waste heat projects in the EEC prepared by Potentiel Energie of Paris covers 46 projects approximately half of which are fish farms and half horticultural projects mainly in the form of greenhouses. About a half of the projects are run on a commercial basis while the other half are Research and Development (R and D) or demonstrations. At least 18 species of fish and 18 species of plant are produced at the various projects but eels and potted plants are grown at more of the commercially orientated projects than any other produce. There has been a significant increase in the number of commercially run projects during the past 10-15 years and this trend is likely to continue in view of the considerable savings that can be made on fuel. The size and number of commercial projects in the UK compares favourably with those in other EEC countries. (author).

5205 Site Resource and Use Studies

Refer also to citation(s) 52047, 52290, 53568

53280 (PB–89-214373/XAB) **Development of a combined quantity and quality model for optimal management of unsteady ground-water flow fields. Technical completion report.** Peralta, R.C.; Solaimanian, J.; Griffis, C.L. Arkansas Univ., Fayetteville, AR (USA). Water Resources Research Center. Jun 1988. 51p. (PUB–134). Available from NTIS, PC A04/MF A01.

See also PB–88-133772.

Alternative techniques are presented for incorporating conservative solute transport equations into computer models designed for optimizing ground-water extraction rates. The equations assume unsteady two-dimensional flow, and dispersed conservative solute transport. Implicit and explicit finite difference equations for solute transport are compared for practicality. After calibration, the equations are used in a MODCON procedure, an integrated series of five optimization or simulation modules. Results of the calculations are compared with those resulting from a model based upon the method of characteristics. The procedure is applicable for an entire aquifer system, or for a subject.

53281 (PB–89-215131/XAB) **Evaluation of nonpotable ground water in the desert area of southeastern California for powerplant cooling.** Steinemann, A.C. Geological Survey, Reston, VA (USA). Water Resources Div. 1989. 52p. (USGS/WATER-SUPPLY-PA–2343). Available from NTIS, PC A04/MF A01.

Also available from Supt. of Docs.\ Library of Congress catalog card no. 89-600019.

Powerplant siting is dependent upon many factors; in southern California the prevailing physical constraint is water availability. Increasing land use and other environmental concerns preclude further sites along the coast. A review of available hydrologic data was made of 142 ground-water basins in the southeast California desert area to ascertain if any could be feasible sources of nonpotable powerplant cooling water. Feasibility implies the capacity to sustain a typical 1,000-megawatt electrical-power generating plant for 30 years with an ample supply of ground water for cooling. Of the 142 basins reviewed, 5 met or exceeded established hydrologic criteria for supplying the water demands of a typical powerplant.

53282 (PB–89-863898/XAB) **Aquifers: Ground-water treatment. January 1977-May 1989 (Citations from the Selected Water Resources Abstracts data base). Report for January 1977-May 1989.** National Technical Information Service, Springfield, VA (USA). Jun 1989. 44p. Available from NTISPC N01/MF N01.

This bibliography contains citations concerning in-situ methods used in the restoration of contaminated aquifers. The utilization of microorganisms, denitrification studies, and the treatment of a number of aromatic hydrocarbons are among the topics discussed. Site-specific studies in a variety of hydrogeological environments are also included. (Contains 55 citations fully indexed and including a title list.)

53283 (PB–89-865752/XAB) **Water-resources data for states (United States). January 1985-July 1989 (Citations from the NTIS data base). Report for January 1985-July 1989.** National Technical Information Service, Springfield, VA (USA). Aug 1989. 158p. Available from NTISPC N01/MF N01.

This bibliography contains citations concerning water-resource data by state. Water-resources data consists of records of stage, discharge, and water quality of streams; the stage, contents, and water quality of lakes and reservoirs; and levels and quality of water wells. Completeness of information varies with each reporting state. Records are kept by the local Geological Survey. Water-quality standards are discussed in a separate bibliography. (Contains 339 citations fully indexed and including a title list.)

5206 Regulations

Refer also to citation(s) 51770, 52276, 52489, 52490, 53247

53 ENVIRONMENTAL–SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social and Economic Studies

Refer also to citation(s) 52157, 52158, 52373

5302 Assessment of Energy Technologies

Refer also to citation(s) 52211, 52212, 52213, 52214, 52222, 52224, 52382, 52391, 52392

53284 (DOE/EA–0372) **Environmental assessment for proposed energy conservation standards for two types of consumer products; refrigerators, refrigerator-freezers, and freezers; small gas furnaces; and a proposed "No standard" standard for television sets.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (USA). 1988. 27p. Sponsored by U.S. DOE Environment Health & Safety. Order Number DE90001108. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This environmental assessment (EA) evaluates the environmental impacts resulting from new or amended energy-efficiency standard

for refrigerators, refrigerator-freezers, freezers, small gas furnaces, and television sets as mandated by the National Appliance Energy Conservation Act of 1987. A complete description of the Engineering and Economic Analysis of the proposed standards may be found elsewhere in the Technical Support Document (TSD). Four of the 14 scenarios for product design changes described in the Engineering Analysis of the TSD are chosen for environmental assessment based on their relative importance as design measures. Values for energy savings that result from product design changes are also taken from the TSD. The two main environmental concerns addressed are emissions from fossil fuel-fired electricity generation and the chlorofluorcarbons used in the production of rigid insulation foam. Each of the 12 design options for refrigerators and freezers result in decreased electricity use and and, therefore, reduced power plant emissions. Design changes that call for additional rigid foam insulation per appliance are of interest because they affect chlorofluorocarbon consumption. There is strong evidence that chlorofluorocarbons migrate to the stratosphere, break down, and catalyze the destruction of stratospheric ozone.

53285 (DOE/EA–0386) **Environmental assessment for proposed energy conservation standards for three types of consumer products: dishwashers, clothes washers and clothes dryers.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (USA). [1989]. 24p. Sponsored by U.S. DOE Environment Health & Safety. Order Number DE90001109. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This environmental assessment (EA) evaluates the environmental impacts resulting from new or amended energy-efficiency standards for dishwashers, clothes washers and clothes dryers as mandated by the National Appliance Energy Conservation Act of 1987. A complete description of the Engineering and Economic Analysis of the proposed standards may be found elsewhere in the Technical Support Document (TSD). All eleven of the scenarios for product design changes described in the Engineering Analysis of the TSD are analyzed in the environmental assessment in the form of levels of pollutant reduction. Level 1 represents the least amount of pollutant reduction, while higher numbered levels represent increasingly more stringent standards, with correspondingly greater reductions in pollutants. Values for energy savings that result from product design changes are taken from the TSD. These energy savings are based on recent data on actual usage rather than DOE test procedures. 12 refs., 1 fig., 12 tabs.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

Refer also to citation(s) 53132

5501 Behavioral Biology

Refer also to citation(s) 53489, 53558

53286 (IAEA-TECDOC–516, pp. 283-291) **Pseuchoneurotic disorders associated with the Chernobyl accident.** Aleksandrovskij, Yu.A. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation Medicine, Kiev (Ukrainian SSR). Jul 1988. (CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

This survey relied largely on random selection. As a rule, the attention of the specialists was directed to people with certain specific complaints. Psychogenic disorders observed in the area of the accident at the Chernobyl plant were followed and studied by a team of specialists from the USSR Ministry of Health, beginning on 29 April 1986. According to the nature of the observed stress effects and of the resultant psychic disorders, it was possible to delineate three periods: first the acute period of the disaster from the time of the accident, lasting about 10 days until completion of the evacuation of the population from the danger zone (5 May); second the intermediate delayed period, the period of comparatively early consequences (from 6 May to October 1986); and third, the period of remote consequences. In the course of the year, 1,572 people were examined. The data available indicate that the psychogenic disorders observed after the Chernobyl accident can be regarded as the consequence of a single process, the dynamics of which are determined on the one hand by the characteristics of the emergency situation and on the other by the traits and the degree of preparedness of the people involved. The special nature of the stress situation in all three periods - the threat to health - gave rise to certain characteristic clinical observations, primarily a high degree of somatization and hypochondria. An understanding of the psychological disorders affecting those who lived through the Chernobyl accident, and of their effects on the work capability and pattern of life of people at various stages after the accident, has made it possible to develop and implement a complex and refined system of prophylactic and medical measures. (author).

5502 Biochemistry

Refer also to citation(s) 53300, 53301, 53399, 53411, 53412, 53489

53287 (CONF-8904252–Summ.) **Nomenclature for physical mapping of complex genomes.** National Inst. of General Medical Sciences, Bethesda, MD (USA); USDOE Office of Energy Research, Washington, DC (USA). Office of Health and Environmental Research; California Univ., San Francisco, CA (USA). Howard Hughes Medical Inst. Aug 1989. 12p. Sponsored by U.S. DOE Energy Research. From Conference on nomenclature for physical mapping of complex genomes; Rockville, MD (USA); 13-14 Apr 1989. Order Number DE89015173. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Among these issues, that of establishing nomenclature conventions, was seen to be fundamental to the development of useful data management systems and essential for the orderly and efficient development of such systems. Therefore, the present workshop was convened, as the first in the recommended series, to identify the issues involved in establishing nomenclature standards and to develop a set of recommendations for such standards. This report summarizes the proceedings of the workshop and lays out specific proposals for naming DNA entities for physical mapping. The scientific community should discuss and develop these proposals so that naming conventions can be established. The proposals apply specifically to human DNA entities; however, the relevance to nomenclature in other systems should be part of the broader discussion. 13 refs.

53288 (JAERI-M–89-052) **Production of cellulase from immobilized Trichoderma reesei.** Kasai, Noboru; Tamada, Masao; Kumakura, Minoru. Japan Atomic Energy Research Inst., Tokyo (Japan). May 1989. 21p. (In Japanese). Order Number DE90709981. Available from NTIS (US Sales Only), PC A03/MF A01.

This report completed the results that obtained on the study of the enzyme activity in the culture of immobilized Trichoderma reesei cells in flask scale (100ml) and bench scale (30l). In the flask scale culture, the batch and repeated batch culture were carried out, and in the bench scale culture, the batch, repeated batch and continuous culture were done by using a culture equipment that is an unit process of the bench scale test plant for saccharification of cellulosic wastes. The enzyme activity of the immobilized cells was higher than that of the intact cells in the flask scale culture and it was confirmed that the enzyme activity was not decreased on the repeated batch culture of six times even. In the bench scale culture, it was found that a optimum culture condition of the immobilized cells was not different from that of the free cells and the immobilized cells gave the enzyme solution with a high enzyme activity in the culture condition of 450rpm stirring speed and air supply of 0.1v/v/m above. The technique of the repeated batch and continuous culture for long times in bench scale without contamination was established. The enzyme activity of the immobilized cells in continuous culture became to be 85 % to that in batch culture and it was found that the enzyme solution with high enzyme activity was continuously obtained in the continuous culture for long times. (author).

53289 (Juel-2251) **Immobilazation of aerobic microorganisms on glassy sintered material, illustrated by the example of the production of L leucine using Corynebacterium glutamicum.** Buechs, J. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Biotechnologie; Technische Univ. Hamburg-Harburg, Hamburg (Germany, F.R.). Dec 1988. 225p. (In German). Order Number DE90711181. Available from NTIS (US Sales Only), PC A10/MF A01.

The aim of this study was to develop the carrier fixation of aerobic microorganisms on open-pore sintered glass material. The fermentative production of L-leucine from α cetonic isocaproic acid with Corynebacterium glutamicum was chosen as an example of a microbial process with a high demand of oxygen. (orig.).

53290 (ORNL/FTR-2530) **[Genetic effects of atomic radiation]: Foreign trip report, March 20-28, 1987.** Selby, P.B. Oak Ridge National Lab., TN (USA). 12 Apr 1987. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89017346. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler attended the Thirty-sixth session of UNSCEAR where he took an active part in the deliberations of the Genetic Sub-subgroup. Good progress was made in discussing the two documents that are in preparation that deal with genetics. Approximately one-third of the traveler's time was spent observing sessions of the main UNSCEAR committee itself, and the remainder was spent in the Genetic Sub-subgroup. Important contacts were made with several prominent geneticists. It was apparent how important it is to ORNL, to DOE, to the United States Government, and to UNSCEAR itself to have at least one representative from the United States on the Genetic Sub-subgroup who has firsthand familiarity with the mouse data that are used to such an important extent in genetic risk estimation. Many of these data were collected in the Biology Division of ORNL.

53291 (ORNL/FTR-2535) **[Enzyme bioassay and the use of enzymes in genetic research]: Foreign trip report, March 11, 1987-March 30, 1987.** Jacobson, K.B. Oak Ridge National Lab., TN (USA). 14 Apr 1987. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89017344. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler spent 16 days in the Department of Genetics of the University of Valencia, Valencia, Spain, to develop a new assay for an enzyme and to present a series of lectures on enzymology. He also discussed research problems with several of the staff of the Department of Genetics.

53292 (ORNL/FTR-2540) **[Protein engineering]: Foreign trip report, April 4-9, 1987.** Mural, R.J. Oak Ridge National Lab., TN (USA). 21 Apr 1987. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89017345. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler attended an international meeting, "Protein Engineering '87'," held at the University of Oxford. Speakers of international standing addressed 425 conferees on topics ranging from the theoretical aspects of protein structure to the therapeutic uses of "engineered" proteins. The traveler presented work of the Protein Engineering Program of the Biology Division at a poster session at this Conference. There were a number of opportunities to interact with colleagues and exchange information concerning this new and rapidly growing field.

53293 (ORNL/FTR-3390) **[Research on Trichoderma cellulases]: Foreign trip report, September 14-20, 1989.** Woodward, J. Oak Ridge National Lab., TN (USA). 29 Sep 1989. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90001095. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler attended TRICEL 89, the first international symposium on Trichoderma cellulases. He presented a paper summarizing his work at ORNL. He also visited Aston University in Birmingham, England, and gave a lecture describing his work at Oak Ridge National Laboratory (ORNL). In Vienna, the latest knowledge concerning Trichoderma cellulases was obtained, and two contacts were established that will lead to unclassified and nonproprietary cooperative research efforts between ORNL and these European colleagues. In Birmingham, unclassified and nonproprietary discussions were held with Professor P.E. Barker and his staff in the Department of Chemical Engineering and Applied Chemistry. As a result of these discussions, areas of research cooperation between ORNL and Aston University were identified, and it is hoped that this cooperation will attract funding from the National Science Foundation (US) and the European Economic Community (EEC).

53294 Regulation of functional cytodifferentiation and histogenesis in mammary epithelial cells: Role of the extracellular matrix. Bissell, M.J. (Lawrence Berkeley Lab., CA (USA)); Ram, T.G. *Environmental Health Perspectives (USA),* 80: 61-70 (Mar 1989). DOE Contract AC03-76SF00098.

Primary mammary epithelial cells provide a versatile system for the study of hormone and extracellular matrix (ECM) influences on tissue-specific gene expression. The authors have characterized the formation of aveolarlike morphogenesis and mammary-specific functional differentiation that occur when these cells are cultured on a reconstituted basement membrane (EHS). Cells cultured on EHS exhibit many ultrastructural and biochemical features indicative of polarized and functionally differentiated mammary epithelium in vivo. The increased expression and specific vectorial secretion of milk proteins into lumina formed in culture are accompanied by large increases in milk protein mRNA expression. However, when individual ECM components are tested, smaller increases in milk protein mRNA are measured on heparan sulfate proteoglycan (HSPG) and laminin, and these responses are not associated with full functional cytodifferentiation or histotypic configuration. This indicates that multiple levels of regulation are involved in mammary-specific gene expression, and that in addition to individual ligand requirements cooperative interactions between various ECM molecules and cells are necessary for functional differentiation in culture. They have also shown that endogenous production of ECM molecules and changes in cell geometry are correlated with changes in functional and histogenic gene expression. They have previously proposed a model of cell-ECM interactions that is consistent with these data.

53295 Changes in nucleosome repeat lengths precede replication in the early replicating metallothionein II gene region of cells synchronized in early S phase. D'Anna, J.A. (Los Alamos National Lab., NM (USA)); Tobey, R.A. *Biochemistry (USA),* 28(7): 2895-2902 (4 Apr 1989).

Previous investigations showed that inhibition of DNA synthesis by hydroxyurea, aphidicolin, or 5-fluorodeoxyuridine produced large changes in the composition and nucleosome repeat lengths of bulk chromatin. There the authors report results of investigations to determine whether the changes in nucleosome repeat lengths might be localized in the initiated replicons, as postulated. In most experiments, Chinese hamster (line CHO) cells were synchronized in G1, or they were synchronized in early S phase by allowing G1 cells to enter S phase in medium containing 1 mM hydroxyurea or 5 μg mL^{-1} aphidicolin, a procedure believed to produce an accumulation of initiated replicons that arise from normally early replicating DNA. Measurements of nucleosome repeat lengths of bulk chromatin, the early replicating unexpressed metallothionein II (MTII) gene region, and a later replicating repeated sequence indicate that the changes in repeat lengths occur preferentially in the early replicating MTII gene region as G1 cells enter and become synchronized in early S phase. During that time, the MTII gene region is not replicated nor is there any evidence for induction of MTII messenger RNA. Thus, the results are consistent with the hypothesis that changes in chromatin structure occur preferentially in the early replicating (presumably initiated) replicons at initiation or that changes in chromatin structure can precede replication during inhibition of DNA synthesis. The shortened repeat lengths that precede MTII replication are, potentially, reversible, because they become elongated when the synchronized early S-phase cells are released to resume cell cycle progression.

53296 Characterization of the cytochrome c oxidase in isolated and purified plasma membranes from the cyanobacterium Anacystis nidulans. Peschek, G.A. (Univ. of Vienna (Austria)); Wastyn, M.; Trnka, M.; Molitor, V.; Fry, I.V.; Packer, L. *Biochemistry (USA),* 28(7): 3057-3063 (4 Apr 1989). DOE Contract FG03-87ER13736.

Functionally intact plasma membranes were isolated from the cyanobacterium (blue-green alga) Anacystis nidulans through French pressure cell extrusion of lysozyme/EDTA-treated cells, separated from thylakoid membranes by discontinuous sucrose density gradient centrifugation, and purified by repeated recentrifugation. Origin and identity of the chlorophyll-free plasma membrane fraction were confirmed by labeling of intact cells with impermeant protein markers, [^{35}S]diazobenzenesulfonate and fluorescamine, prior to membrane isolation. Rates of oxidation of reduced horse heart cytochrome c by purified plasma and thylakoid membranes were 90 and 2 nmol min^{-1} (mg of protein)$^{-1}$, respectively. The cytochrome oxidase in isolated plasma membranes was identified as a copper-containing aa_3-type enzyme from the properties of its redox-active and EDTA-resistant Cu^{2+} ESR signal, the characteristic inhibition profile, reduced minus oxidized difference spectra, carbon monoxide difference spectra, photoaction and photodissociation spectra of the CO-inhibited enzyme, and immunological cross-reaction of two subunits of the enzyme with antibodies against subunits I and II, and the holoenzyme, of Paracoccus denitrificans aa_3-type cytochrome oxidase. The data presented are the first comprehensive evidence for the occurrence of aa_3-type cytochrome oxidase in the plasma membrane of a cyanobacterium similar to the corresponding mitochondrial enzyme.

53297 **Sequence specificity of DNA cleavage by Bis(1,10-phenanthroline)copper(I): Effects of single base pair transitions on the cleavage of preferred pyrimidine-purine-pyrimidine triplets.** Veal, J.M. (Florida State Univ., Tallahassee (USA)); Rill, R.L. *Biochemistry (USA),* 28(8): 3243-3250 (18 Apr 1989).

The cleavage of DNA restriction fragments by bis(1,10-phenanthroline)copper(I) [$[(OP)_2Cu^I]^+$] is sequence dependent: the trimer TAT is most strongly preferred, while the trimer TGT and tetramers TAAT, TAGT, and CAGT are strongly to moderately preferred. $[(OP)_2Cu^I]^+$ cleavage of a series of oligonucleotide duplexes of the type 5'-CCCTPyPuPyCCCC-3'/3'-GGGAPuPyPuGGGG-5' (Py = pyrimidine; Pu = purine) was examined to determine the effects of purine substituents in the central triplet on specificity. The relative cleavage rates of different PyPuPy triplets in oligomers were similar to those observed for restriction fragments. The undecamer duplex containing the trimer TAT (TTATC) was most preferentially cleaved, predominantly at the central adenosine and the adjacent 3'-thymidine. Duplexes differing from TTATC by a single A·T → G·C transition in the central triplet were cleaved at significantly reduced rates relative to TTATC, the order of preference being TAT > TGT > TAC > CAT. The guanine 2-amino group at positions 1 and 2, but not position 3, of a 5'-PyPuPy-3' trimer is implicated as a strong inhibitor of DNA binding by the copper-phenanthroline complex. The influence of the guanine 2-amino group and other features of the cleavage at PyPuPy triplets can be rationalized by a partial intercalation binding model in which one phenanthroline ring system intercalates into the DNA minor groove at the 5'-PyPu-3' step.

53298 **Human genes for complement components C1r and C1s in a close tail-to-tail arrangement.** Kusumoto, H. (Univ. of Michigan Medical School, Ann Arbor (USA)); Hirosawa, S.; Salier, J.P.; Hagen, F.S.; Kurachi, K. *Proceedings of the National Academy of Sciences of the United States of America (USA),* 85(19): 7307-7311 (Oct 1988). DOE Contract FG02-87ER60533.

Complementary DNA clones for human C1s were isolated from cDNA libraries that were prepared with poly(A)$^+$ RNAs of human liver and HepG2 cells. A clone with the largest cDNA insert of 2,664 base pairs (bp) was analyzed for its complete nucleotide sequence. It contained 202 bp of a 5' untranslated region, 45 bp of coding for a signal peptide (15 amino acid residues), 2,019 bp for complement component C1s zymogen (673 amino acid residues), 378 bp for a 3' untranslated region, a stop codon, and 17 bp of a poly(A) tail. The amino acid sequence of C1s was 40.5% identical to that of C1r, with excellent matches of tentative disulfide bond locations conserving the overall domain structure of C1r. DNA blotting and sequencing analyses of genomic DNA and of an isolated genomic DNA clone clearly showed that the human genes for C1r and C1s are closely located in a tail-to-tail arrangement at a distance of about 9.5 kilobases. Furthermore, RNA blot analyses showed that both C1r and C1s genes are primarily expressed in liver, whereas most other tissues expressed both C1r and C1s genes at much lower levels (less than 10% of that in liver). Multiple molecular sizes of specific mRNAs were observed in the RNA blot analyses for both C1r and C1s, indicating that alternative RNA processing(s), likely an alternative polyadenylylation, might take place for both genes.

53299 **Rous sarcoma virus transforming protein tyrosine kinase is expressed and active in sarcoma-free avian embryos microinjected with Rous sarcoma virus.** Howlett, A.R. (Lawrence Berkeley Lab., CA (USA)); Carter, V.C.; Martin, G.S.; Bissell, M.J. *Proceedings of the National Academy of Sciences of the United States of America (USA),* 85(20): 7587-7591 (Oct 1988). DOE Contract AC03-76SF00098.

Early embryonic avian tissue is resistant to transformation by Rous sarcoma virus. To determine the nature of this resistance, the authors examined the expression and properties of the Rous sarcoma virus transforming protein $pp60^{v-src}$, in infected embryonic chicken limbs in ovo. Lysates from Rous sarcoma virus-infected limbs contained the viral structural protein $p19^{gag}$, as detected by immunoblot analysis and showed $pp60^{v-src}$ kinase activity in vitro. Immunoblot analysis of lysates with anti-phosphotyrosine antibodies revealed a number of phosphotyrosine-containing proteins present in lysates of Rous sarcoma virus-infected embryos but not in lysates of control, uninfected embryos. These studies demonstrate that $pp60^{v-src}$ is co-expressed with viral structural determinants in infected embryonic avian tissue. The localization pattern of the major src gene substrate p36 (calpactin I) was compared with that of $p19^{gag}$ by double-label immunofluorescence and found to be generally nonoverlapping. These observations are consistent with the concept that the induction of tumors in ovo requires complementation between viral determinants and host factors. These host factors, which may be critical substrates of $pp60^{src}$, are subject to developmental regulation in the avian embryo.

5503 Cytology

53300 (UCRL–101728) **The glycophorin A assay for somatic cell mutations in humans.** Langlois, R.G.; Bigbee, W.L.; Jensen, R.H. Lawrence Livermore National Lab., CA (USA). 18 Aug 1989. 12p. Sponsored by U.S. Department of Defense; U.S. DOE Energy Research; U.S. Department of Health and Human Services. DOE Contract W-7405-ENG-48. DNA-IARCO-89-869;NIH-ES-83-14. (CONF-8907113–12: 5. international conference on environmental mutagens, Cleveland, OH (USA), 10-15 Jul 1989). Order Number DE90001652. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

In this report we briefly review our past experience and some new developments with the GPA assay. Particular emphasis will be placed on two areas that affect the utility of the GPA assay for human population monitoring. The first is our efforts to simplify the GPA assay to make it more generally available for large population studies. The second is to begin to understand some of the characteristics of human hemopoiesis which affect the accumulation and expression of mutant phenotype cells. 11 refs., 4 figs.

5504 Genetics

Refer also to citation(s) 52277, 53431, 53557, 53563

53301 (DOE/ER/60408–1) **Correlation of chromosome patterns in leukemic cells of patients with exposure to chemicals and/or radiation: Progress report, January 1, 1989–September 30, 1989.** Rowley, J.D. Chicago Univ., IL (USA). Oct 1989. 23p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-86ER60408. Order Number DE90001227. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

We have identified two new recurring translocations involving chromosome 5; one is a 3;5 translocation and the other involves a rearrangement between chromosomes 5 and 7. The first is t(3;5)(q25.1;q35). We studied five patients with AML and a t(3;5) in their leukemic cells. At diagnosis, four of the patients had a t(3;5) as their sole karyotypic anomaly; the remaining patient had additional structural and numerical abnormalities. Careful cytogenetic analysis indicated that the breakpoints of this rearrangement were 3q25.1 and 5q34, in contrast to the various breakpoints reported in earlier studies (3q21 to 3q25 and 5q31 to 5q35). The karyotypic,

morphologic, and clinical characteristics of this group, as well as those of 15 previously reported patients with the t(3;5), were compared to identify any features that might warrant consideration of this anomaly as a specific syndrome. The median age of the group, 37 years, as younger than that of all patients with AML, 49 years. A preceding myelodysplastic syndrome was observed in three patients. We have no information regarding the occupation of most of these patients. Except for acute promyelocytic leukemia, each morphologic subtype occurred in these patients; however, the frequency of erythroleukemia (M6) was much greater than expected. 11 refs., 2 figs., 5 tabs.

53302 (UCRL–101590) **The somatic mutational component of human carcinogenesis.** Mendelsohn, M.L. Lawrence Livermore National Lab., CA (USA). Jul 1989. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. (CONF-8906223–1: Conference on statistical issues in quantitative cancer risk assessment, Snowbird, UT (USA), 18-22 Jun 1989). Order Number DE90001090. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Somatic mutation is the prototypic mechanism for the immediate, irreversible, additive effects that are characteristic of initiation of carcinogenesis. Such genetic changes are often used, explicitly or implicitly, as the transition device between stages in quantitative multistage models designed to describe carcinogenesis. Recent developments in the genetics of cancer and in somatic mutagenesis greatly increase our understanding of these processes, and are worth reviewing in the context of such multistage modelling. 23 refs.

5505 Metabolism

Refer also to citation(s) 52031, 52055, 52737, 53560

53303 (DOE/ER/13765–1) **Separating the influx and efflux components of net uptake of NO_3^- and NH_4^+ with the use of isotopic fractional data: Final report, July 15, 1987–July 14, 1989.** Shearer, G.; Kohl, D.H. Washington Univ., St. Louis, MO (USA). Jul 1989. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER13765. Order Number DE90001200. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Transport processes are central to the life of organisms. It is important to dissect net uptake of metabolites and evaluate its components (influx and efflux). Results of our study have shown that our method, based on isotopic fractionation, is successful in separating the impact of changes in influx vs efflux on changes in net uptake of nitrate and that there is a high probability that the method will be equally successful with ammonium uptake. The methodology is applicable to steady state conditions unlike previous methods which involve the use of ^{15}N or ^{13}N labeled material or ^{14}C labeled analogs. These previous methods require short term measurements, the shorter, the more accurate. The isotopic fractionation methodology will be applicable to steady state experiments with other nutrients containing atoms whose stable isotope abundance is measurable at the level of precision necessary for determination of overall isotopic fractionation factors (e.g., C′, N, O, S). 33 refs., 3 figs., 2 tabs.

53304 A combination of radioanalytical and biochemical methods in the investigation of the selenium metabolism. Behne, D. *Transactions of the American Nuclear Society (USA),* 56: 145 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

As selenium is an essential element, the investigation of its metabolism is of great interest. Analytical methods have been used to determine the selenium levels in tissues of various animal species. Uptake, retention, and excretion of the element have been studied by means of tracer experiments. Considerably more detailed information on the metabolic fate of selenium can be obtained, however, if these methods are applied simultaneously and combined with biochemical procedures for the investigation of biologically important selenium compounds. In this way, the selenium metabolism in the tissues of the rat was studied. The quantitative determination of the element was carried out by instrumental neutron activation analysis via the gamma rays of either the long-lived radioisotope ^{75}Se (0.1-ng detection limit after a 10-day irradiation at a thermal neutron flux density of 5×10^{13} $cm^{-2} \cdot s^{-1}$) or the short lived ^{77m}Se (30-ng detection limit at a flux density of 1×10^{13} $cm^{-2} \cdot s^{-1}$). For the tracer experiments, ^{75}Se was used. In addition to these methods, procedures for the determination of the selenoenzyme glutathione peroxidase and for the investigation of other selenoproteins were applied.

53305 Advance prediction results for selenium measurement by INAA in biological reference materials. Guinn, V.P. (Univ. of California, Irvine (USA)). *Transactions of the American Nuclear Society (USA),* 56: 145-146 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The instrumental neutron activation analysis (INAA) Advance Prediction Computer Program (APCP) has been used to test (a) the detectability of selenium in 11 biological reference materials and (b) the relative advantages of using the 17.4-s ^{77m}Se activity or the 119.8-day ^{75}Se activity for the determination of selenium. The results of the APCP calculations, shown and discussed in this paper, are quite informative.

53306 Molecular neutron activation analysis of selenium metabolites in urine. Blotcky, A.J.; Hansen, G.T.; Ebrahim, A.; Rack, E.P. *Transactions of the American Nuclear Society (USA),* 56: 146-148 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Because of the biological importance of selenium in living biological systems, various analytical procedures have been developed for analysis of microquantities of elemental selenium, in urine, serum, and tissue. For urine selenium, these include atomic absorption spectrometry, solution absorption spectrometry, solution fluorescence spectrometry, volumetry, and neutron activation analysis. Of equal or greater importance is the determination of selenium metabolites present in urine for the purpose of describing the biological pathways for the metabolism of selenium in living organisms. While it is known from previous studies that trimethylselenonium ion (TMSe) is a major metabolite in urine, probably the result of reduction and methylation reaction, there are no definitive results in the literature indicating the nature or quantity of other selenium metabolic products in urine. Early techniques to measure TMSe levels in urine involved the use of the radiotracer ^{75}Se. Because of the long biological half-life of selenium and issues of radiation exposure, its use in humans has been limited. In this paper, the authors report the experimental procedure for the determination of total selenoamino acid concentration in urine and present total selenium values, and, where applicable, TMSe, $SeO^{2-}{}_3$, and total selenoamino acid concentrations in the urine of normal and diseased subjects.

53307 Evaluation of precision and accuracy of selenium measurements in biological materials using neutron activation analysis. Greenberg, R.R. *Transactions of the American Nuclear Society (USA),* 56: 148-149 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

In recent years, the accurate determination of selenium in biological materials has become increasingly important in view of the essential nature of this element for human nutrition and its possible role as a protective agent against cancer. Unfortunately, the accurate determination of selenium in biological materials is often difficult for most analytical techniques for a variety of reasons, including interferences, complicated selenium chemistry due to the presence of this element in multiple oxidation states and in a variety of different organic species, stability and resistance to destruction of some of these organo-selenium species during acid dissolution, volatility of some selenium compounds, and potential for contamination. Neutron activation analysis (NAA) can be one of the best analytical techniques for selenium determinations in biological materials for a number of reasons. Currently, precision at the 1% level (1s) and overall accuracy at the 1 to 2% level (95% confidence interval) can be attained at the U.S. National Bureau of Standards (NBS) for selenium determinations in biological materials when counting statistics are not limiting (using the ^{75}Se isotope). An example of this level of precision and accuracy is summarized. Achieving this level of accuracy, however, requires strict attention to all sources of systematic error. Precise and accurate results can also be obtained after radiochemical separations.

53308 **Nuclear-based methods for the study of selenium.** Spyrou, N.M. (Univ. of Surrey (England)); Akanle, O.A.; Dhani, A. *Transactions of the American Nuclear Society (USA),* 56: 149-150 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The essentiality of selenium to the human being and in particular its deficiency state, associated with prolonged inadequate dietary intake, have received considerable attention. In addition, the possible relationship between selenium and cancer and the claim that selenium may possess cancer-prevention properties have focused research effort. It has been observed in a number of studies on laboratory animals that selenium supplementation protects the animals against carcinogen-induced neoplastic growth in various organ sites, reduces the incidence of spontaneous mammary tumors, and suppresses the growth of transplanted tumor cells. In these research programs on the relationship between trace element levels and senile dementia and depression and the elemental changes in blood associated with selenium supplementation in a normal group of volunteers, it became obvious that in addition to establishing normal levels of elements in the population of interest, there was a more fundamental requirement for methods to be developed that would allow the study of the distribution of selenium in the body and its binding sites. The authors propose emission tomography and perturbed angular correlation as techniques worth exploring.

53309 **Neutron activation of selenium and arsenic with or without chemical separation.** Woittiez, J.R.W. *Transactions of the American Nuclear Society (USA),* 56: 150-151 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

At the Netherland Energy Research Foundation, neutron activation analysis (NAA) is one of the available techniques for elemental analysis. As the technique is potentially very powerful, considerable effort has been invested during the last 2 yr to optimize the multielement performance and to focus simultaneously on the best achievable single-element determination. This last activity implies concentrating the attention on measuring a well-defined signal rather than on software to evaluate complicated signals. As several irradiation facilities can be used, it is possible to choose the best obtainable instrumental activation technique. For the analysis of trace elements on the nanogram per gram level in biological material, however, the reintroduction of chemical separation of irradiated samples is inevitable. This paper presents recent results on applications of this approach. Although several well-documented techniques have been adapted, installed, and applied, and results are obtained for cadmium, molybdenum, chromium, cobalt, tin, iron, and mercury, this discussion is limited to selenium and arsenic.

53310 **Radiochemical methods for selenium in biological materials.** Keydom, K. *Transactions of the American Nuclear Society (USA),* 56: 152 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The concentrations of selenium in many biological materials are high enough to permit determination by instrumental neutron activation analysis (INAA), so that a radiochemical separation is unnecessary. In some cases, however, a lower limit of detection or better precision may be important; in others, the highest possible accuracy is required. Here the lower standard deviations and elimination of interference that can be achieved by radiochemical methods justify the additional effort needed. Radiochemical separation of selenium may be based on: volatilization, precipitation, solvent extraction, adsorption, ion exchange, and other processes or combinations of these methods. In a comprehensive neutron activation analysis with chemical yield determination, the radiochemical separation must be preceded by a total sample decomposition in order that complete carrier equilibration can be ascertained. At the trace level of selenium concentration where both instrumental and radiochemical methods of analysis may give adequate precision, systematic differences between results are found for some matrices.

53311 **Instrumental and preconcentration NAA methods for selenium in biological materials.** Chatt, A. (Dalhousie Univ. (Canada)). *Transactions of the American Nuclear Society (USA),* 56: 152-153 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

At present, selenium is known to be a normal component of several enzymes, proteins, and some aminoacryl transfer nucleic acids. Certain selenium compounds have been reported to possess anticarcinogenic properties, slow the aging process, strengthen the immune system, enhance the sexual functions, etc. In order to understand the role of selenium in human and animal metabolism, analytical methods of high precision and accuracy and of excellent sensitivity are being sought. Neutron activation analysis (NAA) has many advantages that can be exploited for determining selenium. In general, instrumental NAA (INAA) is sensitive enough for the determination of selenium in most biological materials. The determination of very low levels of selenium, e.g., less than 30 ppb, in the presence of large amounts of interfering elements such as sodium, bromine, chlorine, etc., can be facilitated by preconcentration NAA. The technique can also provide superior precision.

53312 **Selenium determinations for the assessment of sample stability in specimen banking.** Zeisler, R.; Greenberg, R.R.; Stone, S.F.; Sullivan, T.M. *Transactions of the American Nuclear Society (USA),* 56: 153-154 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

A comprehensive approach to the analysis of human livers has been developed in a pilot program for a National Environmental Specimen Bank (NESB). Since 1980, the pilot NESB program has examined the collection, processing, storage, and analysis of human livers. Neutron activation analysis (NAA) played a major role in the implemented analytical scheme. Up to 28 elements have been determined by NAA in 96 human livers, which were selected from 3 yr of collection-1980, 1982, and 1984-to establish baseline concentration values at the time the samples were collected and banked. Recently, samples banked in 1980 were withdrawn to be reanalyzed for the assessment of their long-term stability under different storage conditions. Choosing selenium as an example, this paper discusses the NAA procedures needed to arrive at highly precise and accurate data as the basis for the stability evaluation.

53313 **The use of neutron activation analysis to determine selenium status in the Australian diet.** Fardy, J.J.; McOrist, G.; Farrar, Y.J.; Gorman, T.F.; Bowles, C.J. *Transactions of the American Nuclear Society (USA),* 56: 154-155 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Selenium is one of a number of trace elements essential to the human system. Its chief biochemical role is to protect tissue against oxidative damage via the activity of glutathione peroxidase. The toxicity of selenium was well know long before its recognition as an essential trace element. Recent measurements in our laboratory have indicated that the average selenium content in the plasma of Australians is 0.09 $mg \cdot l^{-1}$, which is significantly lower than that found in the inhabitants of most other Western countries. Research aimed at explaining these low levels has begun and involves measurement of selenium concentration in foodstuffs most commonly consumed by the Australian population. An excellent review by Dreosti on selenium stressed the need for this information. In addition, these measurements will include other toxic elements-arsenic, mercury, zinc, and antimony-and the other trace elements determined by instrumental neutron activation analysis (INAA) techniques. To complete the survey of toxic elements, the lead and cadmium in the chosen foodstuffs are being analyzed by anodic stripping voltammetry and inductively coupled plasma mass spectrometry. This paper reports only the NAA results for selenium.

53314 **Determination of sampling constants for selenium by cyclic INAA.** Chatt, A. (Dalhousie Univ. (Canada)); Jayawickreme, C.K. *Transactions of the American Nuclear Society (USA),* 56: 155-156 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Biological reference materials of natural origin and certified elemental composition play an important role in not only evaluating the reliability of a new method but also assuring the quality of data produced in routine analysis. In fact, it has become a common practice to include an appropriate certified reference material (CRM) in every batch of samples analyzed for the purpose of quality assurance. One of the most important properties of a CRM or reference material (RM) should be its degree of homogeneity. For biological

materials, inhomogeneity is inherently associated with their intricate structures. In order to justify the usage of a CRM or RM at a mass lower than that recommended by the issuing agency, is necessary to evaluate the homogeneity at lower mass ranges and to determine the sampling constant for the element of interest. The objectives of the present work are to investigate the homogeneity and to calculate the sampling constants for selenium in several biological CRM and RM that are frequently used to evaluate the accuracy of measurements.

5506 Medicine

Refer also to citation(s) 52846, 53287, 53440, 53442, 53885

53315 (AD-A–209225/2/XAB) **Intraoperative radiation therapy: Characterization and application. Master's thesis.** Ruck, W.R. Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering. Mar 1989. 75p. (AFIT/GNE/ENP–89M-7). Available from NTIS, PC A04/MF A01.

The goal of this project was to define and perform the dosimetry measurements required to characterize a set of 18 applicators for use in Intraoperative Radiation Therapy (IORT). IORT is one of the newest tools in the fight against cancer. In IORT, malignant tumors are exposed directly to high-energy electrons delivered through a specially designed applicator mounted on a linear accelerator. The medical physicist must provide an adequate description of the dose delivery characteristics for every combination of IORT applicator and electron-beam energy. Briefly, the characteristics of interest include: isodose charts, output factors, effective Source-to-Source-Distances (SSDs), offset factors, and Central-Axis (CAX) profiles. Each characteristic is important in the IORT treatment planning process. Isodose charts are used to help select the right combination of IORT applicator and electron-beam energy. Output factors and the offset factors are used to scale the prescribed dose to the appropriate number of monitor units (MUs). CAX profiles are used to find surface dose factors, output factors, and x-ray dose factors. Radiographic film is used to obtain the isodose charts and CAX profiles. Effective SSDs are measured using a parallel-plate ionization chamber. In general the results are comparable to those found by personnel at the Mayo Clinic for their IORT system. The only difference is the observation that effective SSDs are dependent upon the diameter of the IORT applicator and the electron-beam energy.

53316 (BNL–43271) **Epithermal beam development at the BMRR [Brookhaven Medical Research Reactor]: Dosimetric evaluation.** Saraf, S.K.; Fairchild, R.G.; Kalef-Ezra, J.; Laster, B.H.; Fiarman, S.; Ramsey, E. Brookhaven National Lab., Upton, NY (USA). 24 Aug 1989. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8903150–4: Workshop on neutron beam design, development and performance for neutron capture therapy, Cambridge, MA (USA), 30-31 Mar 1989). Order Number DE90001272. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The utilization of an epithermal neutron beam for neutron capture therapy (NCT) is desirable because of the increased tissue penetration relative to a thermal neutron beam. Over the past few years, modifications have been and continue to be made at the Brookhaven Medical Research Reactor (BMRR) by changing its filter components to produce an optimal epithermal beam. An optimal epithermal beam should contain a low fast neutron contamination and no thermal neutrons in the incident beam. Recently a new moderator for the epithermal beam has been installed at the epithermal port of the BMRR and has accomplished this task. This new moderator is a combination of alumina (Al_2O_3) bricks and aluminum (Al) plates. A 0.51 mm thick cadmium (Cd) sheet has reduced the thermal neutron intensity drastically. Furthermore, an 11.5 cm thick bismuth (Bi) plate installed at the port surface has reduced the gamma dose component to negligible levels. Foil activation techniques have been employed by using bare gold and cadmium-covered gold foil to determine thermal as well as epithermal neutron fluence. Fast neutron fluence has been determined by indium foil counting. Fast neutron and gamma dose in soft tissue, free in air, is being determined by the paired ionization chamber technique, using tissue equivalent (TE) and graphite chambers. Thermoluminescent dosimeters (TLD-700) have also been used to determine the gamma dose independently. This paper describes the methods involved in the measurements of the above mentioned parameters. Formulations have been developed and the various corrections involved have been detailed. 12 refs.

53317 (BNL–43330) **Contrast agent choice for intravenous coronary angiography.** Zeman, H.D.; Siddons, D.P. Brookhaven National Lab., Upton, NY (USA). 1989. 26p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016;FG03-87ER60527. (CONF-890802–6: 7. synchrotron radiation instrumentation (SRI) national conference, Berkeley, CA (USA), 6-10 Aug 1989). Order Number DE90001549. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The screening of the general population for coronary artery disease would be practical if a method existed for visualizing the extent of occlusion after an intravenous injection of contrast agent. Measurements performed with monochromatic synchrotron radiation x-rays and an iodine containing contrast agent at the Stanford Synchrotron Radiation Laboratory have shown that such an intravenous angiography procedure would be possible with an adequately intense monochromatic x-ray source. Because of the size and cost of synchrotron radiation facilities it would be desirable to make the most efficient use of the intensity available, while reducing as much as possible the radiation dose experienced by the patient. By choosing contrast agents containing elements with a higher atomic number than iodine, it is possible to both improve the image quality and reduce the patient radiation dose, while using the same synchrotron source. By using Si monochromator crystals with a small mosaic spread, it is possible to increase the x-ray flux available for imaging by over an order of magnitude, without any changes in the storage ring or wiggler magnet. The most critical imaging task for intravenous coronary angiography utilizing synchrotron radiation x-rays is visualizing a coronary artery through the left ventricle or aorta which also contains a contrast agent. Calculations have been made of the signal to noise ratio expected for this imaging task for various contrast agents with atomic numbers between that of iodine and bismuth.

53318 (DOE/ER/60407–3) **Improving cancer treatment with cyclotron produced radionuclides: Progress report: Retrospective summary, 1958–1988.** Laughlin, J.S.; Larson, S.M. Sloan-Kettering Inst. for Cancer Research, New York, NY (USA). 1988. 76p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-86ER60407. Order Number DE90001207. Available from NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.

This new DOE proposal appropriately builds on past developments. The development and application of radionuclides for diagnosis, treatment and research has been a continuing concern for more than the past three decades. A brief description of this development and previous achievements was considered important in order to provide a frame of reference for the evolving program here. Earlier, the use of certain radionuclides, radon progeny and I-131 in particular, and also x-rays, had been developed by the work of such pioneers as Failla, Quimby and Marinelli. In 1952, at the instigation of Dr. C.P. Rhoads, Director of both Memorial Hospital and Sloan-Kettering Institute, the restoration of the Department of Physics and Biophysics was undertaken in response to a perceived need to promote the utilization of radionuclides and of high energy radiations for therapeutic, diagnostic and research purposes. This resulted in several research and developmental projects with close clinical collaboration in areas of radiation treatment; medical studies with radionuclides and labeled compounds; the diagnostic uses of x-rays; and some projects in surgery and other clinical areas. Aspects of some of these projects that have had some relevance for the evolving AEC-DOE projects are outlined briefly. 34 refs.

53319 (INIS-SU–110/A, pp. 177-181) **Needless method of intratumoral injection of radiopharmaceuticals of treatment purpose.** Sedov, V.V.; Matveev, V.A.; Slobodyanik, I.I.; Nazarov, S.M. Institut Biofiziki, Moscow (USSR). 1988. (In Russian). In *Radiopharmaceuticals in oncology. Collection of scientific papers.* Order Number DE90705929. Available from NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS.

L-41571.

It is shown that using needless method of radiopharmaceutical injection under high pressure into a tumour to irradiate it a an infiltration of tumour of large size with a preparation is guaranteed. Radiation loads of personnel are decreased when using the method. It is expedient to examine a needless method of radiopharmaceutical injection under pressure to irradiate a tumor in order to assess efficiency of irradiation using the above method of injection.

53320 (INIS-SU–115/A) **Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.** Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. 145p. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

This document contains abstracts from papers presented at the conference of Roentgenologists and Radiologists of Byelorussian SSr held in Grodno September 8-9, 1988.

53321 (INIS-SU–115/A, pp. 4-10) **Some aspects of state and development of roentgenology in Byelorussian SSR.** Markvartse, M.M. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. BIOMEDICAL RADIOGRAPHY/byelorussian ssr; DIAGNOSIS; EFFICIENCY; MEDICAL EXAMINATIONS; NUCLEAR MEDICINE; RADIOLOGICAL PERSONNEL; RADIOLOGY; X-RAY EQUIPMENT

53322 (INIS-SU–115/A, pp. 11-12) **Functional roentgenoscopy of stomach and duodenum in diagnosis of chronic duodenal permeability disturbance.** Baranov, V.V. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. SMALL INTESTINE/biomedical radiography; STOMACH/biomedical radiography; ABDOMEN; BIOLOGICAL FUNCTIONS; DIAGNOSIS; DIGESTIVE SYSTEM DISEASES; PATIENTS; STOMACH; SYMPTOMS

53323 (INIS-SU–115/A, pp. 13-14) **Roentgenologic peculiarities of osteogeni.** Avdej, L.L.; Trusevich, V.A.; Vasil'eva, N.N.; Frolov, G.N. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. METASTASES/biomedical radiography; SARCOMAS/metastases; DIAGNOSIS; LUNGS; METASTASES; PATIENTS; SARCOMAS; SKELETON; TIME DEPENDENCE

53324 (INIS-SU–115/A, pp. 14-16) **Clinical symptoms (masks) and diagnosis of lime dystrophia of pancreas.** Ambrozajtis, K.I.; Vitonas, A.M. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. PANCREAS/biomedical radiography; PANCREAS/diagnosis; DIGESTIVE SYSTEM DISEASES; PANCREAS; DIAGNOSIS; PATHOLOGICAL CHANGES; PATIENTS; SYMPTOMS

53325 (INIS-SU–115/A, pp. 16-17) **Colour-equidensity roentgenodiagnosis of lung diseases.** Amosov, I.S.; Degtyarev, V.A. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. LUNGS/biomedical radiography; RESPIRATORY SYSTEM DISEASES/diagnosis; COLOR; EFFICIENCY; LUNGS; PATIENTS; DIAGNOSIS

53326 (INIS-SU–115/A, pp. 18-19) **Roentgenological picture of vagotomized stomach.** Batvinkov, N.I.; Gubar', L.M.; Mozhejko, M.A.; loskevich, N.N. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. STOMACH/biomedical radiography; BIOLOGICAL FUNCTIONS; DIAGNOSIS; EXCRETION; PATIENTS; STOMACH; SURGERY; VAGUS

53327 (INIS-SU–115/A, pp. 23-25) **Echoscanning in diagnosis of non-functioning gallbladder.** Borejko, S.B. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. BILIARY TRACT/biomedical radiography; PATHOLOGICAL CHANGES/diagnosis; CALCULI; IMAGES; DIAGNOSIS; PATIENTS; SURGERY; SYMPTOMS; ULTRASONIC WAVES

53328 (INIS-SU–115/A, pp. 25-26) **Refit disease (clinical variants).** Vitenas, A.M.; Ambrozajtis, K.I. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. DIAPHRAGM/biomedical radiography; DIAPHRAGM/pathological changes; ANATOMY; DIAGNOSIS; DIAPHRAGM; PATIENTS; SYMPTOMS

53329 (INIS-SU–115/A, pp. 27-28) **Lymphography in patients with malignant neoplasms of ovaries.** Vishnevskaya, E.E.; Shelepen', K.G. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. METASTASES/biomedical radiography; METASTASES/lymphatic system; DIAGNOSIS; METASTASES; NEOPLASMS; OVARIES; PATIENTS; SYMPTOMS

53330 (INIS-SU–115/A, pp. 31) **Value of computerized tomography in examination of injuries of verterbrae and spinal cord.** Voronovich, I.R.; Sel'khov, Yu.I.; Pustovojtenko, V.T.; Nikitina, L.I. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. VERTEBRAE/computerized tomography; VERTEBRAE/injuries; BONE MARROW; DIAGNOSIS; EFFICIENCY; PATIENTS; VERTEBRAE; INJURIES

53331 (INIS-SU–115/A, pp. 33-34) **Peculiarities of tuberculosis bronchopulmonary lesions.** Galyuzhin, E.D. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian).

(CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. TUBERCULOSIS/diagnosis; AGE DEPENDENCE; BIOMEDICAL RADIOGRAPHY; BRONCHI; LUNGS; PATHOLOGICAL CHANGES; PATIENTS; SEX DEPENDENCE; TUBERCULOSIS; DIAGNOSIS

53332 (INIS-SU–115/A, pp. 34-36) **Comparative roentgenoplanimetric characteristics of sigmoid colon and rectum in normal state and in patients with functional intestinal dyspepsia and chronic colitis.** German, V.M.; Malevich, Eh.E. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. DIGESTIVE SYSTEM DISEASES/diagnosis; LARGE INTESTINE/biomedical radiography; COMPARATIVE EVALUATIONS; DIAGNOSIS; EFFICIENCY; MORPHOLOGICAL CHANGES; PATIENTS

53333 (INIS-SU–115/A, pp. 36-37) **Comparative general roentgenoplanimetric characteristics of rectum in normal state and in patients with chronic colitis.** German, V.M. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. LARGE INTESTINE/biomedical radiography; COMPARATIVE EVALUATIONS; DIAGNOSIS; DIGESTIVE SYSTEM DISEASES; PATIENTS

53334 (INIS-SU–115/A, pp. 38-40) **Modern possibilities of complex introscopic diagnosis of stomach cancer.** Golub, G.D.; Fisher, M.E.; Serova, T.N. and others. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. NEOPLASMS/diagnosis; STOMACH/biomedical radiography; EFFICIENCY; MEDICAL EXAMINATIONS; METASTASES; NEOPLASMS; DIAGNOSIS; PATIENTS; STOMACH; SURGERY; ULTRASONOGRAPHY

53335 (INIS-SU–115/A, pp. 40-41) **Roentgenoendovascular diagnosis of ovarial veins varicose dilation in infertile women.** Grakova, L.S.; Galkin, E.V.; Naumova, E.B. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. OVARIES; REPRODUCTIVE DISORDERS/diagnosis; VASCULAR DISEASES/diagnosis; BIOMEDICAL RADIOGRAPHY; BLOOD CIRCULATION; OVARIES; PATIENTS; DIAGNOSIS; VEINS; WOMEN

53336 (INIS-SU–115/A, pp. 41-43) **State of binary and pancreatic tract in patiets with inflammation of pancreas.** Grenkov, G.I.; Kogan-Azaryan, V.A. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. BILIARY TRACT/biomedical radiography; INFLAMMATION/diagnosis; PANCREAS/biomedical radiography; EFFICIENCY; INFLAMMATION; DIAGNOSIS; PANCREAS; PATIENTS; SYMPTOMS

53337 (INIS-SU–115/A, pp. 43-44) **Experience in transcutaneous puncture and catheterization of biliary tract.** Grishin, I.N.; Korostelev, Yu.V. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. BILIARY TRACT/biomedical radiography; DIAGNOSIS; JAUNDICE; LIVER; PATIENTS; SURGERY

53338 (INIS-SU–115/A, pp. 44-45) **On pulmonary echinococcosis diagnosis.** Gubar', L.M.; Nalivajko, D.D.; Karaush, O.M.; Rozhko, V.V. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. BACTERIAL DISEASES/diagnosis; LUNGS/bacterial diseases; LUNGS/biomedical radiography; BACTERIA; DIAGNOSIS; LUNGS; PATHOLOGICAL CHANGES; PATIENTS; SYMPTOMS

53339 (INIS-SU–115/A, pp. 46-47) **Role of constitutional factor in determination of heart size.** Dondua, L.G.; Kutateladze, N.M.; Samojlenko, G.A. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. HEART/fluoroscopy; HEART/medical examinations; ANATOMY; CHEST; HEART; FLUOROSCOPY; IMAGES; PATIENTS

53340 (INIS-SU–115/A, pp. 49-50) **Modern possibilities of radiological investigation methods in diagnosis and evaluation of lung cancer therapy efficiency.** Dudarev, V.S.; Golub, G.D.; Zharkov, V.V. and others. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. LUNGS/biomedical radiography; LUNGS/nuclear medicine; NEOPLASMS/diagnosis; EFFICIENCY; LUNGS; NEOPLASMS; DIAGNOSIS; PATIENTS

53341 (INIS-SU–115/A, pp. 53-54) **On differentiation of lober hypoplasia and chronic pneumonia.** Zagorodskaya, M.M.; Antonova, R.A.; Kareva, E.A.; Koval', G.Yu. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. PNEUMONIA/biomedical radiography; PNEUMONIA/diagnosis; LUNGS; PATHOLOGICAL CHANGES; PATIENTS; PNEUMONIA; DIAGNOSIS; SYMPTOMS

53342 (INIS-SU–115/A, pp. 55-56) **Roentgenodiagnosis of lung traume after closes injury of chest.** Zverev, L.A.; Tsarikov, V.V.; Gombalevskij, N.K.; Chevidaev, N.E. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation*

diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports. Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. LUNGS/biomedical radiography; LUNGS/injuries; CHEST; DIAGNOSIS; LUNGS; INJURIES; PATIENTS; SYMPTOMS

53343 (INIS-SU–115/A, pp. 58-60) **State of small intestine after duodenae ulcerrhaphy.** Il'yashevich, E.V. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. 1 tab. SMALL INTESTINE/biomedical radiography; DIAGNOSIS; PATIENTS; SURGERY; ULCERS

53344 (INIS-SU–115/A, pp. 60-62) **Small intestine in defayed time after trunk vagotomy.** Il'yashevich, E.V.; Shaplyko, V.I. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. 1 tab. SMALL INTESTINE/biomedical radiography; BIOLOGICAL FUNCTIONS; DIAGNOSIS; PATIENTS; SURGERY; SYMPTOMS; ULCERS; VAGUS

53345 (INIS-SU–115/A, pp. 62-63) **Roentgenoradiological investigation of children with mechanical injuries of kidneys and urinary tract.** Kasaev, A.A.; Tsvetkova, I.G. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. KIDNEYS/biomedical radiography; KIDNEYS/injuries; URINARY TRACT/biomedical radiography; URINARY TRACT/injuries; CHILDREN; DIAGNOSIS; EFFICIENCY; KIDNEYS; INJURIES; NUCLEAR MEDICINE; PATIENTS

53346 (INIS-SU–115/A, pp. 65-67) **Cholepnevmoduodenography in complex roentgenoendoscopic investigation in patients with duodenal diverticulum.** Kulikov, V.A.; Ivanov, V.I. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. SMALL INTESTINE/biomedical radiography; SMALL INTESTINE/pathological changes; BLOOD VESSELS; DIAGNOSIS; IMAGES; PATIENTS

53347 (INIS-SU–115/A, pp. 67-68) **Efficiency of roentgenological investigations in diagnosis of myocardial infarction and left ventricular failure.** Kutateladze, N.M.; Kvaliashvili, Yu.A.; Khvichiya, N.Ya. and others. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. HEART FAILURE/biomedical radiography; MYOCARDIAL INFARCTION/biomedical radiography; BIOLOGICAL FUNCTIONS; DIAGNOSIS; EFFICIENCY; PATIENTS

53348 (INIS-SU–115/A, pp. 68-69) **Resolution of review roentgenography of chest organs in diagnosis of acute respiratory failure.** Lazyuk, I.I.; Sergeeva, A.A.; Borisevich, G.A. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. CHEST/biomedical radiography; RESPIRATORY SYSTEM DISEASES/diagnosis; CHEST; CHILDREN; EFFICIENCY; PATIENTS; RESOLUTION; DIAGNOSIS; SYMPTOMS

53349 (INIS-SU–115/A, pp. 70-71) **Chronic carditis (clinico-roentgeno-morphological comparison).** Lazyuk, I.I.; Lazyuk, D.G.; Puchkov, G.F. and others. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. CARDIOVASCULAR DISEASES/diagnosis; MYOCARDIUM/biomedical radiography; DIAGNOSIS; CHILDREN; MORPHOLOGICAL CHANGES; MYOCARDIUM; PATIENTS; SYMPTOMS

53350 (INIS-SU–115/A, pp. 73) **Experience on roentgenological diagnosis of duodenal permeability failure.** Lifshits, S.Z.; Chulkova, O.M. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. SMALL INTESTINE/biomedical radiography; BIOLOGICAL FUNCTIONS; DIAGNOSIS; DYNAMIC FUNCTION STUDIES; PATHOLOGICAL CHANGES; PATIENTS

53351 (INIS-SU–115/A, pp. 74-76) **Uniform dilatation of biliary ducts as index of Sphincter Mirizzi hypoplasia.** Markvarde, M.M.; Ehranos'yan, M.G. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. 1 tab. BILIARY TRACT/biomedical radiography; DIGESTIVE SYSTEM DISEASES/diagnosis; ANATOMY; BIOLOGICAL FUNCTIONS; DIAGNOSIS; PATHOLOGICAL CHANGES; PATIENTS; SYMPTOMS

53352 (INIS-SU–115/A, pp. 82-83) **On roentgenodiagnosis of irritable colon syndrome.** Mikhajlov, A.N.; Malevich, Eh.E. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. LARGE INTESTINE/biomedical radiography; PATHOLOGICAL CHANGES/diagnosis; BIOLOGICAL FUNCTIONS; DIAGNOSIS; PATIENTS; SYMPTOMS

53353 (INIS-SU–115/A, pp. 84-85) **Improved roentgenological technique for gastroesophageal reflux indentification.** Mogil'nitskaya, M.A.; Levin, M.D. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. ESOPHAGUS/biomedical radiography; ESOPHAGUS/pathological changes; STOMACH/biomedical radiography; STOMACH/pathological changes; DIAGNOSIS; EFFICIENCY; ESOPHAGUS; PATIENTS; STOMACH

53354 (INIS-SU–115/A, pp. 86-87) **Radiation burdens on patients and medical personnel durng investigations on X-ray computerized tomographe.** Moroz, N.S.; Ostapenko, N.I. Minskij

Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380--: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. COMPUTERIZED TOMOGRAPHY/dosimetry; COMPUTERIZED TOMOGRAPHY/radiation doses; RADIOLOGICAL PERSONNEL/radiation doses; DOSIMETRY; DIAGNOSIS; EFFICIENCY; PATIENTS; X RADIATION

53355 (INIS-SU--115/A, pp. 87-89) **Differential roentgenodiagnosis of stomach ulceration.** Nekrashevich, V.V.; Zhakova, L.A.; Filippovich, N.S.; Korostelev, Yu.V. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380--: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. STOMACH/biomedical radiography; DIAGNOSIS; NEOPLASMS; PATHOLOGICAL CHANGES; PATIENTS; STOMACH; SYMPTOMS

53356 (INIS-SU--115/A, pp. 89-91) **Complex roentgenoradiological and endoscopic examination in evaluation of kidney functions and some causes of their failure in patients with ureterosigma anastomosis.** Nechiporenko, N.A.; Galkin, L.P.; Bushanova, Z.V. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380--: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. KIDNEYS/biomedical radiography; KIDNEYS/nuclear medicine; UROGENITAL SYSTEM DISEASES/diagnosis; BIOLOGICAL FUNCTIONS; KIDNEYS; PATHOLOGICAL CHANGES; PATIENTS; URINARY TRACT; DIAGNOSIS

53357 (INIS-SU--115/A, pp. 91-92) **Forecasting significance of fluoroscopic data (according to materials of patients dead of heart ischemia and hypertension).** Nizovtsova, L.A. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380--: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. CARDIOVASCULAR DISEASES/fluoroscopy; CARDIOVASCULAR DISEASES/forecasting; FLUOROSCOPY; FORECASTING; EFFICIENCY; PATIENTS; SYMPTOMS

53358 (INIS-SU--115/A, pp. 93-94) **Roentgenological evaluation of the efficiency of physical exercises during rehabilitation therapy of patients with myocardial infarction.** Nizovtsova, L.A.; Al'khimovich, V.M.; Rusetskaya, V.G. and others. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380--: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. BIOMEDICAL RADIOGRAPHY/myocardial infarction; MYOCARDIAL INFARCTION/exercise; MYOCARDIAL INFARCTION/therapy; DIAGNOSIS; EFFICIENCY; EXERCISE; THERAPY; PATIENTS

53359 (INIS-SU--115/A, pp. 95-96) **Zonography in children with kidney developmental anomaly.** Petkevich, G.V. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380--: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. KIDNEYS/pathological changes; URINARY TRACT/biomedical radiography; CHILDREN; DIAGNOSIS; KIDNEYS; PATIENTS

53360 (INIS-SU--115/A, pp. 96-97) **Computerized tomography in diagnosis of chronic pancreatitis.** Petukhov, V.N.; Sel'khov, Yu.I.; Gulitskaya, L.I.; Silivonchik, N.N. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380--: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. DIGESTIVE SYSTEM DISEASES/diagnosis; PANCREAS/computerized tomography; DIAGNOSIS; PANCREAS; PATIENTS; SYMPTOMS

53361 (INIS-SU--115/A, pp. 98-100) **Roentgenological approach to differential diagnosis of cardialgias.** Rozhkovskaya, V.V.; Romanenko, T.V. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380--: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. CHEST/biomedical radiography; CHEST; DIAGNOSIS; HEART; PATIENTS; SKELETON; STOMACH; SYMPTOMS

53362 (INIS-SU--115/A, pp. 28-30) **Use of radionuclide evaluation method of drugs (obsidan, pirroxan) effect on haemodynamics in lesser circulation in patients with hypertension.** Volkov, N.F.; Ersh, I.R.; Zajtsev, V.I.; Tekhneryadov, V.I. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380--: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. HYPERTENSION/blood circulation; HYPERTENSION/nuclear medicine; BIOLOGICAL FUNCTIONS; DIAGNOSIS; DRUGS; HYPERTENSION; PATIENTS

53363 (INIS-SU--115/A, pp. 30) **Effect of sustac on haemodynamics in patients with ishemia by radiocirculographic data.** Volkov, N.F.; Snezhitskij, V.A.; Borejsho, D.E.; Mironchik, E.V. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380--: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. BLOOD CIRCULATION/diagnosis; BIOLOGICAL FUNCTIONS; DIAGNOSIS; DRUGS; EFFICIENCY; ISCHEMIA; NUCLEAR MEDICINE; PATIENTS; THERAPY

53364 (INIS-SU--115/A, pp. 32-33) **Radionuclide method of evaluation of effective kidney blood circulation changes under the effect of anapryline intake in patients with chronic ishemia.** Galkin, L.P.; Snezhitskij, V.A.; Kurejsha, Eh.K. and others. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380--: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. BLOOD CIRCULATION/dynamic function studies; DIAGNOSIS; DRUGS; ISCHEMIA; KIDNEYS; NUCLEAR MEDICINE; PATIENTS; THERAPY

53365 (INIS-SU--115/A, pp. 47-49) **Causes of failure during intravenous choleography and possibilities of their removal.** Druzhinina, V.S.; Melekhova, L.S. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380--: 4. conference of roentgenologists and radiologists of Byelorussian SSR,

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Short note. NUCLEAR MEDICINE/biliary tract; BLOOD CIRCULATION; DIAGNOSIS; EFFICIENCY; LIVER; PATIENTS; RECTAL ADMINISTRATION; XENON 133

53366 (INIS-SU–115/A, pp. 77-78) **Radionuclide method in diagnosis of mitral heart failure.** Mironchik, E.V.; Rakov, A.V. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. HEART FAILURE/diagnosis; BLOOD CIRCULATION; DIAGNOSIS; NUCLEAR MEDICINE; PATHOLOGICAL CHANGES; PATIENTS

53367 (INIS-SU–115/A, pp. 71-72) **Study on mobility of stomach antral part during preoperative radiotherapy.** Lesik, A.M.; Sukolinskij, V.N.; Sosnovskij, A.N.; Malakhov, A.V. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. NEOPLASMS/radiotherapy; DYNAMIC FUNCTION STUDIES; EFFICIENCY; NEOPLASMS; RADIOTHERAPY; PATIENTS; STOMACH; SURGERY

53368 (INIS-SU–115/A, pp. 103-104) **Roentgenocardiometry in patients with acute myocardial infarction.** Savchenko, A.P.; Tsellagova, Z.S.; Bakashvili, N.G. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. MYOCARDIAL INFARCTION/diagnosis; AGE DEPENDENCE; BIOMEDICAL RADIOGRAPHY; EFFICIENCY; DIAGNOSIS; PATIENTS

53369 (INIS-SU–115/A, pp. 106-108) **Roentgenological features of bile hypertension in patients with non-functioning gallbladder.** Sergeeva, I.I. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. BILIARY TRACT/biomedical radiography; BILE; BIOLOGICAL FUNCTIONS; DIAGNOSIS; HYPERTENSION; PATIENTS; SYMPTOMS

53370 (INIS-SU–115/A, pp. 108-109) **Roentgenosemiotics of cyst hypoplasia of lungs in children.** Sokur, P.P.; Bondarenko, A.P.; Pojda, Z.S. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. LUNGS/biomedical radiography; PATHOLOGICAL CHANGES/diagnosis; CHILDREN; LUNGS; DIAGNOSIS; PATIENTS; SYMPTOMS

53371 (INIS-SU–115/A, pp. 110-111) **Tactics of application of roentgenoendovascular dilatation during bilateral stenosing of kidney arteries.** Tarakanov, Yu.P. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. ARTERIES/biomedical radiography; ARTERIES; KIDNEYS; PATIENTS

53372 (INIS-SU–115/A, pp. 111-113) **Clinico-roentgenological characteristics of recurring form of nonspecific ulcerative colitis.** Timofeev, V.M. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. DIGESTIVE SYSTEM DISEASES/diagnosis; LARGE INTESTINE/biomedical radiography; DIAGNOSIS; PATIENTS; SYMPTOMS

53373 (INIS-SU–115/A, pp. 113-115) **Clinico-roentgenological characteristics of transitory form of nonspecific ulcerative colitis.** Timofeev, V.M. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. DIGESTIVE SYSTEM DISEASES/diagnosis; LARGE INTESTINE/biomedical radiography; DIAGNOSIS; PATIENTS; SEX DEPENDENCE; SYMPTOMS

53374 (INIS-SU–115/A, pp. 115-119) **Function of external respiration under normal conditions by roentgenopneumopolygraphic data.** Tikhomirova, T.F. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. 1 tab. LUNGS/biomedical radiography; RESPIRATION/dynamic function studies; AGE DEPENDENCE; LUNGS; PATIENTS; RESPIRATION; SEX DEPENDENCE

53375 (INIS-SU–115/A, pp. 119-123) **Peculiarities of regional reserve lung ventilation in patients with collagenoses by dynamic roentgenopneumopolygraphy data.** Tikhomirova, T.F. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. 2 tabs. LUNGS/biomedical radiography; RESPIRATION/dynamic function studies; EXERCISE; LUNGS; PATHOLOGICAL CHANGES; PATIENTS; RESPIRATION

53376 (INIS-SU–115/A, pp. 124-126) **Experience in roentgendiagnosis of cardiomyopathy.** Filippovich, N.S.; Nekrashevich, V.V.; Strel'chenya, S.N. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. CARDIOVASCULAR DISEASES/diagnosis; MYOCARDIUM/biomedical radiography; DIAGNOSIS; MYOCARDIUM; PATIENTS; SYMPTOMS

53377 (INIS-SU–115/A, pp. 102-103) **Probe relaxational duodenography as a means of diagnosis of chronic partial duodenal ileus.** Savitskaya, T.A.; Silivonchik, N.N. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian).

(CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. SMALL INTESTINE/biomedical radiography; BIOLOGICAL FUNCTIONS; DIAGNOSIS; PATHOLOGICAL CHANGES; PATIENTS; SYMPTOMS

53378 (INIS-SU–115/A, pp. 127-128) **Actual problems of roentgenodiapeutics in patients with thorax and abdomen cavities diseases.** Fisher, M.E.; Dudarev, V.S.; Mashevskij, A.A. and others. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. ABDOMEN/biomedical radiography; CHEST/biomedical radiography; ABDOMEN; CHEST; DIAGNOSIS; EMBOLI; NEOPLASMS; ORGANS; PATIENTS; SURGERY

53379 (INIS-SU–115/A, pp. 129-131) **On differential diagnosis of some pathological processes of ileocecal area.** Khlystov, V.A.; Zhegin, V.A.; Belosel'skij, N.N. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. INTESTINES/biomedical radiography; PATHOLOGICAL CHANGES/diagnosis; INTESTINES; DIAGNOSIS; PATIENTS; SYMPTOMS

53380 (INIS-SU–115/A, pp. 131-133) **Roentgenoangiographic indices in evaluation of the state of coronary channel therminal area.** Tsapaeva, N.L.; Tarakanov, Yu.P.; Polonetskij, L.Z. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. CORONARIES/biomedical radiography; ISCHEMIA/diagnosis; BLOOD CIRCULATION; CORONARIES; ISCHEMIA; DIAGNOSIS; PATIENTS

53381 (INIS-SU–115/A, pp. 133-134) **Roentgenological evaluation of phase character of small intestine digestive motility.** Cheremukhin, E.P. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. SMALL INTESTINE/biomedical radiography; SMALL INTESTINE/dynamic function studies; DIAGNOSIS; PATIENTS

53382 (INIS-SU–115/A, pp. 135-136) **Roentgenofunctional evaluation of small intestine motility evacuation from stomach and gallbladder in children.** Cheremukhin, E.P.; Sushchevskij, B.P.; Klintsevich, N.V. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. BILIARY TRACT/biomedical radiography; SMALL INTESTINE/biomedical radiography; STOMACH/biomedical radiography; CHILDREN; DIAGNOSIS; DYNAMIC FUNCTION STUDIES; PATIENTS; STOMACH

53383 (INIS-SU–115/A, pp. 136-138) **Technique of roentgenological investigation of children with bronchial obturation.** Shirokoborodyj, G.G.; Zverev, L.A.; Katul'ko, V.A.; Novik, A.N. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. BRONCHI/biomedical radiography; PATHOLOGICAL CHANGES/diagnosis; BRONCHI; CHILDREN; EFFICIENCY; DIAGNOSIS; PATIENTS

53384 (INIS-SU–115/A, pp. 138-139) **Role of myxional cystography in diagnosis of bladder-ureteral refluxes by data of children's nephrological department of Gomel' regional hospital.** Shilenok, S.P.; Gribova, A.I. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. PATHOLOGICAL CHANGES/diagnosis; URINARY TRACT/biomedical radiography; BIOLOGICAL FUNCTIONS; BYELORUSSIAN SSR; CHILDREN; DIAGNOSIS; PATIENTS; SYMPTOMS

53385 (INIS-SU–115/A, pp. 100-101) **Possibilities of radionuclide diagnosis of chronic pulmonary heart.** Ryzhij, V.A. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. LUNGS/nuclear medicine; RESPIRATORY SYSTEM DISEASES/diagnosis; BLOOD CIRCULATION; EFFICIENCY; LUNGS; PATIENTS; DIAGNOSIS

53386 (INIS-SU–115/A, pp. 105-106) **Functional state of kidneys by data of radionuclide investigations in patients with stomach carcinoma, treated with platydiam.** Sachivko, N.V.; Usova, M.P. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. KIDNEYS/dynamic function studies; KIDNEYS/nuclear medicine; CHEMOTHERAPY; DIAGNOSIS; KIDNEYS; NEOPLASMS; PATIENTS; STOMACH

53387 (INIS-SU–115/A, pp. 128-129) **Some conclusions on the work of radiological department of children's medical institution.** Filippkin, M.A.; Pykov, M.I. Minskij Meditsinskij Inst., Minsk (Byelorussian SSR). 1988. (In Russian). (CONF-8809380–: 4. conference of roentgenologists and radiologists of Byelorussian SSR, Grodno (USSR), 8 Sep 1988). In *Actual problems of radiation diagnosis of thorax and abdomen organs' diseases. Vol. 1. Summaries of reports.* Order Number DE90705923. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Short note. DIGESTIVE SYSTEM DISEASES/nuclear medicine; CHILDREN; DIAGNOSIS; DIAGNOSTIC TECHNIQUES; GASTROINTESTINAL TRACT; PATIENTS

53388 (INIS-SU–116/A, pp. 64-66) **X-ray diagnosis of intestinal radiation injuries developed after radiation treatment of cervix uteri carcinoma.** Volodina, G.I. (Kazanskij Inst. Usovershenstvovaniya Vrachej, Kazan (USSR)); Abdulkhakova, D.A. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In

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TB-02620.

Short note. RADIATION INJURIES/diagnosis; RADIOTHERAPY/side effects; BIOMEDICAL RADIOGRAPHY; CARCINOMAS; LARGE INTESTINE; PATIENTS; DIAGNOSIS; RADIOTHERAPY; UROGENITAL SYSTEM DISEASES

53389 (INIS-SU–116/A, pp. 87-89) **Ultrasonic examination of patients with delayed radiation injuries.** Mukhamedzhanov, I.Kh.; Dergachev, A.I.; Omarov, A.A. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02620.

Short note. RADIATION INJURIES/diagnosis; RADIOTHERAPY/side effects; DELAYED RADIATION EFFECTS; NEOPLASMS; PATIENTS; DIAGNOSIS; RADIOTHERAPY; ULTRASONIC WAVES

53390 (INIS-SU–116/A, pp. 17-20) **Use of biological isoeffective dose concept to prevent delayed radiation injuries.** Chekhonadskij, V.N. (Akademiya Meditsinskikh Nauk SSSR, Moscow (USSR). Onkologicheskij Nauchnyj Tsentr); Spasokukotskaya, O.N.; Borisov, A.P. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02620.

Short note. RADIOTHERAPY/delayed radiation effects; RADIOTHERAPY/integral doses; BIOLOGICAL LOCALIZATION; EQUATIONS; NEOPLASMS; PATIENTS; RADIOTHERAPY

53391 (INIS-SU–116/A, pp. 20-22) **Forecasting of early and delayed local complications in radiation treatment of neoplasms.** Zholkiver, I.I. (Kazakhskij Nauchno-Issledovatel'skij Inst. Onkologii i Radiologii, Alma-Ata (USSR)). Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02620.

Short note. FORECASTING/delayed radiation effects; FORECASTING/early radiation effects; RADIOTHERAPY/planning; RADIOTHERAPY/side effects; EQUATIONS; FORECASTING; INTEGRAL DOSES; NEOPLASMS; PATIENTS; RADIOTHERAPY; PLANNING

53392 (INIS-SU–116/A, pp. 23-24) **Assurance role of radiation treatment quality in prophylaxis of local radiation injuries.** Denisenko, O.N.; Yarzutkin, V.V. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02620.

Short note. RADIOTHERAPY/local radiation effects; RADIOTHERAPY/quality assurance; DATA PROCESSING; DOSIMETRY; IRRADIATION DEVICES; OPTIMIZATION; PATIENTS; PLANNING; RADIOTHERAPY

53393 (INIS-SU–116/A, pp. 31-32) **Efficient treatment plan of neoplasms of some localization as a possibility of decreasing radiation injuries and complications.** Kolesnikova, V.A. (Rostovskij-na-Donu Nauchno-Issledovatel'skij Onkologicheskij Inst., Rostov-na-Donu (USSR)); Rubtsov, V.R.; Rozenko, L.Ya.; Zaderin, V.P.; Efimova, L.G. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02620.

Short note. RADIOTHERAPY/neoplasms; RADIOTHERAPY/optimization; BIOLOGICAL LOCALIZATION; CHEMOTHERAPY; ESOPHAGUS; INTEGRAL DOSES; LOCAL RADIATION EFFECTS; PATIENTS; RADIOTHERAPY; NEOPLASMS; OPTIMIZATION; SIDE EFFECTS; UROGENITAL SYSTEM DISEASES

53394 (INIS-SU–116/A, pp. 33-35) **Modern feasibilities of radiation injuries forecasting in patients with cervix uteri carcinoma.** Mar'ina, L.A. (Akademiya Meditsinskikh Nauk SSSR, Moscow (USSR). Onkologicheskij Nauchnyj Tsentr); Lilhovetskaya, R.B.; Morozova, S.Yu. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02620.

Short note. RADIATION INJURIES/forecasting; RADIOTHERAPY/side effects; CARCINOMAS; COMPUTERIZED TOMOGRAPHY; INTEGRAL DOSES; OPTIMIZATION; PATIENTS; PLANNING; FORECASTING; RADIOTHERAPY; RECTUM; URINARY TRACT; UROGENITAL SYSTEM DISEASES

53395 (INIS-SU–116/A, pp. 35-36) **Hyperglycemia in complex therapy of postirradiation recurrences and complications in case of cervix uteri carcinoma.** Makhmudova, M.T.; Zakirkhodzhaev, U.D. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02620.

Short note. RADIATION INJURIES/chemotherapy; RADIATION INJURIES/hyperglycemia; RADIOTHERAPY/side effects; CARCINOMAS; LOCAL RADIATION EFFECTS; OPTIMIZATION; PATIENTS; CHEMOTHERAPY; HYPERGLYCEMIA; RADIOTHERAPY; UROGENITAL SYSTEM DISEASES

53396 (INIS-SU–116/A, pp. 52-55) **Comparative assessment of effect of various types of radiation treatment on thyroid function in patients with pharynx neoplasm.** Filippov, K.G. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02620.

Short note. NEOPLASMS/pharynx; RADIATION INJURIES/thyroid; RADIOTHERAPY/side effects; ANOXIA; BIOLOGICAL FUNCTIONS; INTEGRAL DOSES; NEOPLASMS; PHARYNX; PATIENTS; THYROID; RADIOTHERAPY; RESPONSE MODIFYING FACTORS

53397 (INIS-SU–116/A, pp. 37-38) **Results of radiation treatment of patients with cervix uteri carcinoma of 2-3 stage at the Curietron and Selectron devices.** Khangel'dyan, A.G.; Ter-Pogosyan, Z.R.; Gasparyan, M.G.; Adamyan, A.G.

Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432--: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02620.

Short note. RADIOTHERAPY/optimization; BIOLOGICAL RADIATION EFFECTS; CARCINOMAS; DRUGS; IMMUNITY; IRRADIATION DEVICES; PATIENTS; RADIOTHERAPY; OPTIMIZATION; SIDE EFFECTS; UROGENITAL SYSTEM DISEASES

53398 (INIS-SU--116/A, pp. 38-40) **Forecasting of radiation response and complications in radiation treatment of minor pelvis organs.** Sidorchenkov, V.O.; Chilingarov, K.M. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432--: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02620.

Short note. RADIATION INJURIES/forecasting; RADIOTHERAPY/side effects; INTEGRAL DOSES; PATIENTS; FORECASTING; RADIOTHERAPY; RECTUM; URINARY TRACT

53399 (INIS-SU--131/A) **Interferon inductors and other immunomodulators in radiology and oncology. Scientific reports collection.** Akademiya Meditsinskikh Nauk SSSR, Moscow (USSR); Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii, Obninsk (USSR). 1988. 126p. (In Russian). Order Number DE90705924. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02943.

This document is a collection of papers concerning interferon.

53400 (INIS-SU--131/A, pp. 75-78) **Immunocorrection with levamysole in combined therapy of patients with rectum neoplasm according to theophyline tests.** Filatov, P.P.; Neprina, G.S.; Panteleeva, E.S.; Berdov, B.A. Akademiya Meditsinskikh Nauk SSSR, Moscow (USSR); Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii, Obninsk (USSR). 1989. (In Russian). In *Interferon inductors and other immunomodulators in radiology and oncology. Scientific reports collection.* Order Number DE90705924. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02943.

It is shown that application of immunotherapy by levamysole up to initiation of combined treatment of patients suffering from rectum cancer can be considered as justified. But a protective effect of this treatmet in relation to radiation injury of lymphocytes and acceleration of recovery of their quantity occur only in operable patients while in the group of primarily non-operable patients a positive (curative) levamysol effect is absent or weakly manifested. 3 refs.

53401 (INIS-SU--131/A, pp. 78-83) **Immunomodifying effect of VCG vaccine in treatment of urinary bladder neoplasm.** Neprina, G.S.; Panteleeva, E.S.; Vatin, O.E.; Karyakin, O.B.; Kurasova, V.G.; Filatov, P.P.; Dunchik, V.N. Akademiya Meditsinskikh Nauk SSSR, Moscow (USSR); Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii, Obninsk (USSR). 1989. (In Russian). In *Interferon inductors and other immunomodulators in radiology and oncology. Scientific reports collection.* Order Number DE90705924. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02943.

It is shown that immunotherapy realization using VCG vaccine after completion of PCT (polychemotherapy) course in patients suffering from later stages of urinary bladder neoplasm, allowed one to maximally connect stages of chemo- and radiation therapy at the expense of sufficient increase of the quantity of main groups of immunocompetent cells. Introduction of incometacin to immunocorrection scheme allowed one to remove disbalance in immunoregulating lymphocyte system which testifies to advisability of combined applicaion of VCG vaccine and indometacin in complex treatment of cerinary bladder neoplasms. 5 refs.

53402 (INIS-SU--131/A, pp. 83-87) **Test of leukocytes suppression in assessment of antitumoral immunity in oncourology.** Vatin, O.E.; Karyakin, O.B.; Sviridova, T.V.; Sirotkina, N.P.; Dunchik, V.N. Akademiya Meditsinskikh Nauk SSSR, Moscow (USSR); Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii, Obninsk (USSR). 1989. (In Russian). In *Interferon inductors and other immunomodulators in radiology and oncology. Scientific reports collection.* Order Number DE90705924. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02943.

Specific antitumoral immunity in patients suffering from urinary bladder neoplasm (UBN) and prostate neoplasms was studied before treatment and at different stages of immuno-, chemo- and radiation therapy. Data allowing one to believe that the tests of leukocyte adhesion suppression and serum blocking activity determination clearly reflect the development of non-specific leukocyte sensibilization in patients to corresponding tumor antigen which testifies to advisability of applying the tests indicated as additional ones in diagnosis and evaluation of antitumoral immunity, are presented. 6 refs.

53403 (INIS-SU--131/A, pp. 96-98) **Effect of hyperglycemia on the function of immunoregulatory cells and production of interleukine-2.** Savina, N.P. Akademiya Meditsinskikh Nauk SSSR, Moscow (USSR); Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii, Obninsk (USSR). 1989. (In Russian). In *Interferon inductors and other immunomodulators in radiology and oncology. Scientific reports collection.* Order Number DE90705924. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02943.

Functional properties of immunoregulatory cells in Con-A-induced suppressing activity test as well as interleukine-2-producing activity (IL-2) of lymphocytes are studied. It is shown that germinative factor increase at the final treatment stage levels the immunosuppressing effect of radiation therapy on immunoregulatory cells. So, regional artificial hyperglycemia applied in combination with traditional treatment methods produces a modulating effect on immunoregulatory cell function and lymphokine production. 4 refs.

53404 (INIS-SU--131/A, pp. 107-115) **Comparison of immunoregulators number and their functioning in case of lymphogranulomatosis. Modifying effect of component of complex treatment and other factors on immunoregulatory function.** Kuz'mina, E.G.; Yarilin, A.A.; Bajsogolov, G.D.; Shakhtarina, S.V. Akademiya Meditsinskikh Nauk SSSR, Moscow (USSR); Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii, Obninsk (USSR). 1989. (In Russian). In *Interferon inductors and other immunomodulators in radiology and oncology. Scientific reports collection.* Order Number DE90705924. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02943.

It is shown that cyclic functioning of non-specific regulators, lymphocyte proliferation is connected with periodic variations of suppressive cell quantity and helper/suppressor ratio. Ability of a number of substances (Con A, adenosine, theophylline, levanysole and diucyphon) to modify spontaneous regulators function and peculiarities of their effect on healthy people under active LG and continuous remission is revealed. 4 refs.; 1 tab.

53405 (INIS-SU--131/A, pp. 121-125) **Immunocorrection in radiation and combined treatment of neoplasms.** Karpova, N.A. Akademiya Meditsinskikh Nauk SSSR, Moscow (USSR); Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii, Obninsk (USSR). 1989. (In Russian). In *Interferon inductors and other immunomodulators in radiology and oncology. Scientific reports collection.* Order Number DE90705924. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02943.

Data on the efficiency of a number of immunostimulating preparations under radiation and combined therapy of oncologic patients, testifying to the prospects of such investigations to increase the treatment efficiency, are presented. Possibilities of choosing such preparations, data on mechanisms and effect on separate components of immunity system under their suppression by oncologic, radiation and other factors are insufficient for a wide practical application. 15 refs.

53406 (LA-UR–89-1520) **Use of superconducting plates and shells to deflect magnetic noise fields: Application to MEG [magnetoencephalography].** Overton, W.C. Jr.; van Hulsteyn, D.B.; Flynn, E.R. Los Alamos National Lab., NM (USA). [1989]. 3p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-891148–1: 11. annual international conference of the IEEE Engineering in Medicine and Biology Society, Seattle, WA (USA), 9-12 Nov 1989). Order Number DE89012592. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Insertion of a superconducting plate or shell in a magnetic field causes a surface current distribution which opposes the applied field. Resultant fields near plate edges are higher while those near centers are much lower than applied fields. We make use of these principles in MEG by placing suitably oriented gradiometers at points where noise fields are smallest. Signals from nearby brain wave sources are enhanced because the net signal is a combination of that from the sources and that from its image. The principles of noise deflection and source imaging are applied to new concepts of gradiometry. 4 refs., 2 figs.

53407 (LUMEDW-MEOK–1007-1-79-1985) **ADPRT inhibitors and hyperthermia as radiosensitizers. Mechanistic studies using human leukocytes in vitro and a C3H mouse mammary carcinoma in vivo.** Jonsson, G.G. Lund Univ. Hospital (Sweden). Dept. of Oncology. 15 May 1985. 90p. Order Number DE90605244. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

Hyperthermia given in combination with gamma radiation has given considerable improvement in the therapeutic results for treatment of malignant tumors. The mechanism behind the hyperthermia effect is probably operative at the tissue level as well as at the molecular level. The metabolism of NAD^+ in relation to the activity of the chromosomal enzyme ADP-ribosyl transferase (ADPRT) has been studied as a possible molecular mechanism for this effect. The ADPRT activity was measured after radiosensitization with both hyperthermia and nicotinamide, which is a potent inhibitor of ADPRT. The results indicate that hyperthermia can improve the effect of radiotherapy by reducing the supply of NAD^+, which is a co-substrate for ADPRT, while nicotinamide functions as a radiosensitizing agent by direct inhibition of the enzyme. The hypothesis is discussed in the thesis where inhibition of ADPRT might increase the radiosensitivity because the radiation-induced DNA damage can not be repaired with normal efficiency. The function of nicotinamide as a radiosensitizer was verified by studies on C3H mice with transplanted spontaneous mammary tumors. Because nicotinamide is not toxic, it seems quite attractive to test this vitamin as a radiosensitizing agent against human tumors. (251 refs.) (author).

53408 (PB–89-205215/XAB) **Routine compliance testing for diagnostic x-ray systems or components of diagnostic x-ray systems to which 21 CFR subchapter J is applicable.** Food and Drug Administration, Rockville, MD (USA). Center for Devices and Radiological Health. Dec 1988. 361p. (FDA/CDRH–89/90). Available from NTIS, PC A16/MF A01.

Supersedes PB–84-190958 and PB–85-146132.

This manual was developed by the National Center for Devices and Radiological Health, FDA, to establish procedures for routine testing of diagnostic x-ray systems for compliance with Federal Performance Standard 21 CFR 1021.30. It has been prepared to instruct FDA personnel and State officials who assist FDA in the use of the various devices that FDA may procure. The procedures and routine test equipment will be used for screening diagnostic x-ray systems for evidence of non-compliance with the Performance Standard. More rigorous followup testing will be performed as required. The manual has two major subject areas: testing procedures and test equipment. The first section presently contains procedures that provide efficient means of testing against many performance requirements and are applicable to many different types of x-ray systems. It includes detailed drawings of the routine compliance test stand, operating manuals for the x-ray exposure monitor and the photometer, and descriptions of how to use the direct-print paper.

53409 Myocardial ischaemia and clinical applications of positron emission tomography. Armbrecht, J.J. (California Univ., Los Angeles, CA (USA). Div. of Nuclear Medicine and Biophysics); Schelbert, H.R. *Nuklearmediziner (F.R. Germany),* 12(2): 93-107 (Apr 1989). (In German).

Positron emission tomography (PET) permits non-invasive investigation and quantification of regional blood flow and metabolic rates in the human myocard. In cases of myocardial ischaemia PET reveals the presence and extent of surviving tissue in dysfunctional myocardium and differenciates it from irreversible tissue damage and scar formation. Since metabolic markers have proven more precise and reliable than conventional diagnostic procedures in the identification of surviving myocard, the PET gains increasing importance in the evaluation of severity and extent of ischaemic cell damage. Based on these findings it is possible to stratify patients with acute or chronic myocardial ischaemia to the most effective treatment. (orig.).

53410 Conformational analysis of d(C_3G_3), a B-family duplex in solution. Wolk, S. (Univ. of California, Berkeley (USA)); Thurmes, W.N.; Ross, W.S.; Hardin, C.C.; Tinoco, I. Jr. *Biochemistry (USA),* 28(6): 2452-2459 (21 Mar 1989). DOE Contract FG03-86ER60406.

NMR and circular dichroism studies of the duplex formed by the self-complementary DNA hexanucleotide d(C_3G_3) indicate that it is a B-type structure but differs from standard B-form. An analysis of NMR coupling constants within the deoxyribose moieties yields a 70% or greater contribution from pseudorotation phase angles corresponding to the C3'-exo conformation, a conformation similar to the C2'-endo conformation associated with B-form DNA. Intranucleotide interproton distances are consistent with a B-form structure, but some internucleotide distances are intermediate between A- and B-form structures. Circular dichroism spectra have B-form characteristics but also include an unusual negative band at 282 nm. The solution spectroscopic results are in contrast with X-ray crystallographic studies which find A-form structures for similar sequences.

53411 Method for protecting bone marrow against chemotherapeutic drugs and radiation therapy using transforming growth factor beta 1. Keller, J.R.; Ruscetti, F.W.; Wiltrout, R. To Department of Health and Human Services, Washington, DC. USA Patent 7-372,815. 29 Jun 1989. 32p. Available from NTIS, PC A03/MF A01.

This Government-owned invention available for U.S. licensing and, possibly, for foreign licensing. Copy of application available NTIS.

Presented is a method for protecting hematopoietic stem cells from the myelotoxicity of chemotherapeutic drugs or radiation therapy, which comprises administering to a subject a therapeutically effective amount of transforming growth factor beta 1 for protecting bone marrow from the myelotoxicity of chemotherapeutic drugs or radiation therapy.

5507 Microbiology

Refer also to citation(s) 51621, 51628, 51640, 52056

53412 (DOE/ER/60248–T1) **Decomposition in Arctic terrestrial environments: Project summary document.** Laursen, G.A. Alaska Univ., Fairbanks, AK (USA). School of Agriculture and Land Resource Management. 1989. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract FG06-84ER60248. Order Number DE90001198. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The principal goal of this research unit is to further elucidate the rate and quality of microbial decomposition within cold, wet, Arctic tundra peat soils found in water tract systems of Foothills Province terrain (8-10°) on the north slope of Alaska. Research objectives include demonstration of of four hypotheses. A positive correlation exists between the rate of decomposing litter and the viable microbial (fungal) biomass, as measured by ARP activities and direct counts, associated with that litter. In Arctic tundra peat soil systems, there exists a positive correlation between the presence and abundance of viable mycelial biomass and the enzymatic potential for degradative activity as measured by the presence of cellulase, peroxidase, chitinase and protease enzymes produced by the miocrobial community. Substrate quality, as defined by lignin to cellulose ratios, influences the rate of natural litter decomposition. The lignin to total nitrogen ratio describes an inverse correlation to decomposition rates of litter.

53413 (ORNL/FTR–2848) **[Genetically engineered microorganisms]: Foreign trip report, April 1–9, 1988.** Sharples, F.E.

Oak Ridge National Lab., TN (USA). 18 Apr 1988. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89017409. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler attended the First International Conference on the Release of Genetically Engineered Microorganisms at the request of the United Nations Environment Programme (UNEP). The purpose of the conference was to provide an international forum for the discussion of the issues and concerns related to the release of genetically engineered microorganisms for environmental and agricultural applications. The cost of attendance was paid by UNEP, a group with whom a small Work-for-Others contract (to participate in developing international biosafety guidelines) is under discussion.

5509 Pathology

Refer also to citation(s) 53301

53414 (LBL-PUB–659-9/89) **High-resolution PET [positron emission tomography] for medical science studies.** Budinger, T.F.; Derenzo, S.E.; Huesman, R.H.; Jagust, W.J.; Valk, P.E. Lawrence Berkeley Lab., CA (USA). Sep 1989. 17p. Sponsored by U.S. DOE Energy Research; U.S. Department of Health and Human Services. DOE Contract AC03-76SF00098. Order Number DE90000130. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

One of the unexpected fruits of basic physics research and the computer revolution is the noninvasive imaging power available to today's physician. Technologies that were strictly the province of research scientists only a decade or two ago now serve as the foundations for such standard diagnostic tools as x-ray computer tomography (CT), magnetic resonance imaging (MRI), magnetic resonance spectroscopy (MRS), ultrasound, single photon emission computed tomography (SPECT), and positron emission tomography (PET). Furthermore, prompted by the needs of both the practicing physician and the clinical researcher, efforts to improve these technologies continue. This booklet endeavors to describe the advantages of achieving high resolution in PET imaging. 6 refs., 21 figs.

5510 Physiological Systems

Refer also to citation(s) 53399

53415 (LA-UR–89-3192) **Monitoring chaos of cardiac rhythms.** Mayer-Kress, G. Los Alamos National Lab., NM (USA). [1989]. 10p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. (CONF-8910223–1: BIOTECH USA: 6th annual industry conference and exhibition, San Francisco, CA (USA), 2-4 Oct 1989). Order Number DE90000692. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Chaos theory provides a new paradigm in monitoring complexity changes in heart rate variability. Even in cases where the spectral analysis only shows broad band characteristics estimations of dimensional complexity parameters can show quantitative changes in the degree of chaos present in the interbeat interval dynamics. We introduce the concept of dimensional complexity as dynamical monitoring parameter and discuss its properties in connection with control data and data taken during cardiac arrest. Whereas dimensional complexity provides a quantitative indicator of overall chaotic behavior, recurrence plots allow direct visualization of recurrences in arbitrary high dimensional pattern-space. In combination these two methods from non-linear dynamics exemplify a new approach in the problem of heart rate monitoring and identification of precursors of cardiac arrest. Finally we mention a new method of chaotic control, by which selective and highly effective perturbations of nonlinear dynamical systems could be used for improved pacing patterns. 11 refs., 6 figs.

53416 **Cadmium accelerates bone loss in ovariectomized mice and fetal rat limb bones in culture.** Bhattacharyya, M.H. (Argonne National Lab., IL (USA)); Whelton, B.D.; Stern, P.H.; Peterson, D.P. *Proceedings of the National Academy of Sciences of the United States of America (USA),* 85(22): 8761-8765 (Nov 1988). DOE Contract W-31-109-ENG-38.

Loss of bone mineral after ovariectomy was studied in mice exposed to dietary cadmium at 0.25, 5, or 50 ppm. Results show that dietary cadmium at 50 ppm increased bone mineral loss to a significantly greater extent in ovariectomized mice than in sham-operated controls. These results were obtained from two studies, one in which skeletal calcium content was determined 6 months after ovariectomy and a second in which ^{45}Ca release from ^{45}Ca-prelabeled bones was measured immediately after the start of dietary cadmium exposure. Furthermore, experiments with ^{45}Ca-prelabeled fetal rat limb bones in culture demonstrated that Cd at 10 nM in the medium, a concentration estimated to be in the plasma of mice exposed to 50 ppm dietary Cd, strikingly increased bone resorption. These in vitro results indicate that cadmium may enhance bone mineral loss by a direct action on bone. Results of the in vivo studies are consistent with a significant role of cadmium in the etiology of Itai-Itai disease among postmenopausal women in Japan and may in part explain the increased risk of postmenopausal osteoporosis among women who smoke.

5520 Public Health

Refer also to citation(s) 53137

53417 (PB–89-202709/XAB) **Health promotion/hazard protection at the workplace: A NIOSH (National Institute for Occupational Safety and Health) position and planning guide.** Cohen, A. National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Biomedical and Behavioral Science. 27 Oct 1983. 28p. Available from NTIS, PC A03/MF A01.

A position statement and framework for advancing health-promotion ideas and related functions concerned with worker well-being at the job site were developed. The study demonstrated the range of possibilities within current NIOSH surveillance, epidemiology, control research, information dissemination and training activities for developing such an integrated program. Specific tasks dealt with by the working group and reported on included: shaping a position for NIOSH on traditional health-promotion activities which would be compatible with the mandated concerns for protection from hazards at the workplace; inventorying NIOSH projects which included elements having significance to health promotion; and developing a framework to be used in organizing current and future work, mixing health promotion with workplace hazard protection objectives. The author suggests that the theme endorsing worker participation in hazard-recognition and monitoring programs should be further developed. Flagging real or suspected job safety hazards and rating their impact on worker-safety attitudes and injury rates should be explored. Additional emphasis is needed on the effect of various lifestyle features on occupational risk factors.

53418 (PB–89-203129/XAB) **Occupational safety and health guidelines for chemical hazards. (Publication No. 88-118).** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). 1988. 201p. (DHHS/PUB/NIOSH–88-118-SUPPL-1-OHG). Available from NTIS, PC A10/MF A01.

Also available from Supt. of Docs.

A compilation of 35 occupational safety and health guidelines was developed for the purpose of disseminating the information to workers, employers, and to professionals in the field of occupational safety and health. The guidelines were for individual substances and included the following information: chemical names and synonyms, chemical and physical properties, exposure limits, signs and symptoms of exposure, recommendations for medical monitoring, respiratory and personal protective equipment, and control procedures.

53419 (PB–89-203137/XAB) **Occupational safety and health guidelines for chemical hazards. (Publication No. 89-104).** National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). 1988. 176p. (DHHS/PUB/NIOSH–89-104-SUPPL-2-OHG). Available from NTIS, PC A09/MF A01.

Also available from Supt. of Docs.

A compilation of 30 occupational safety and health guidelines was developed for the purpose of disseminating the information to workers, employers, and to professionals in the field of occupational safety and health. The guidelines were for individual substances

and included the following information: chemical names and synonyms, chemical and physical properties, exposure limits, signs and symptoms of exposure, recommendations for medical monitoring, respiratory and personal protective equipment, and control procedures.

5530 Agriculture and Food Technology

Refer also to citation(s) 52048, 52725, 53231

53420 (CNIC–00216) **Studies of irradiation sterilization for single infusion device.** Chen Ruyan; Wang Keqin; Lu Zongmeng; Xiao Fenyuan; Xie Meizhi. China Nuclear Information Centre, Beijing, BJ (China). May 1988. 11p. (In Chinese). Order Number DE90604926. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

In practice of irradiation sterilization for single infusion device, object bacteria were selected and then their radiosensitivity were tested on the basis of practical production and irradiation environment. In view of the cylinder source and the static irradiation form, the dose rate of irradiation field and the dose distribution and uniformity in product box were measured in order to control sterilization quality. Through the measurements of material properties for irradiated infusion device and the test of causing rabbit fever as well as the survey of clinical practice, it was verified that the irradiation apparatus, the irradiation process and the product material etc. can satisfy the demands of sterilixzation and praction.

53421 (IAEA-AL–017) **Report of the consultants' meeting on "fallout radioactivity monitoring in environment and food" (MEF), French Nuclear Research Centre, Cadarache, France, 15-17 July 1987.** International Atomic Energy Agency, Seibersdorf (Austria). Laboratories. 1989. 11p. (CONF-8707218–: Consultants' meeting on fallout radioactivity monitoring in environment and food, Cadarache (France), 15-17 Jul 1987). Order Number DE90604920. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The purpose of the Consultants' Meeting was to get further advice on how the knowledge and experience gained from different activities since the last meeting could be beneficially implemented in the on-going Programme on "Fallout Radioactivity Monitoring in Environment and Food".

53422 (IAEA-AL–019, pp. 129-137) **Activities regarding the monitoring of radionuclides in food and environmental samples in the department ENEA-PAS.** Ingrao, G. (ENEA, Casaccia (Italy). Centro Ricerche Energia). International Atomic Energy Agency, Seibersdorf (Austria). Laboratories. 1989. (CONF-8809405–: Consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna (Austria), 5-9 Sep 1988). In *Report of the consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna, 5-9 September 1988.* Order Number DE90603824. Available from NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS.

The report presents the results of the monitoring of radionuclides in food and environmental samples. A description of the available facilities and measurement systems are also presented. 11 refs, 4 figs, 1 tab.

53423 (IAEA-AL–019, pp. 138-141) **Estimate of the cesium-137 activity in reindeer meat by external γ-measurement of living animal.** Falk, R. (National Inst. of Radiation Protection, Stockholm (Sweden)); Aakerblom, G. International Atomic Energy Agency, Seibersdorf (Austria). Laboratories. 1989. (CONF-8809405–: Consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna (Austria), 5-9 Sep 1988). In *Report of the consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna, 5-9 September 1988.* Order Number DE90603824. Available from NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS.

A simple and rapid measurement method is described for selection of animals for slaughter or selecting animals for foddering as the cesium-137 activity in the meat may exceed the limit value for sale. 1 ref., 3 figs.

53424 (INIS-BR–1647) **Radioimmunological determination of free total insulin and C-peptide in insulin treated diabetics.** Toledo e Souza, I.T. de; Okada, H. Comissao Nacional de Energia Nuclear, Rio de Janeiro, RJ (Brazil). 1989. 1p. Order Number DE90606533. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Published in summary form only. PEPTIDES/insulin; PEPTIDES/radioimmunology; DIABETES MELLITUS; MEASURING METHODS; PEPTIDES; INSULIN; RADIOIMMUNOLOGY

53425 (PB–89-208391/XAB) **Economic analysis of electron accelerators and cobalt-60 for irradiating food. Technical bulletin.** Morrison, R.M. Economic Research Service, Washington, DC (USA). Commodity Economics Div. Jun 1989. 45p. (USDA/TB–1762). Available from NTIS, PC A03/MF A01.

Average costs per pound of irradiating food are similar for the electron accelerator and cobalt-60 irradiators analyzed in the study, but initial investment costs can vary by $1 million. Irradiation costs range from 0.5 to 7 cents per pound and decrease as annual volumes treated increase. Cobalt-60 is less expensive than electron beams for annual volumes below 50 million pounds. For radiation-source requirements above the equivalent of 1 million curies of cobalt-60, electron beams are more economical.

53426 **Food irradiation. Hearing before the Subcommittee on Health and the Environment of the Committee on Energy and Commerce, House of Representatives, One Hundredth Congress, First Session on H.R. 956, June 19, 1987.** Serial No. 100-81. 280p. Government Printing Office, Washington, DC (US) (1988).

Government officials and representatives from health and food service groups were among those testifying on H.R. 956, the Food Irradiation Safety and Labeling Requirement Act of 1987. The area of most concern was to evaluate the actions of the Food and Drug Administration in approving the use of food irradiation technology and to discuss whether the FDA decision was the right one.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

Refer also to citation(s) 52302, 52303, 52310, 52315, 53235, 53275, 53286, 53389, 53391, 53394, 53396, 53423, 53612, 53878

53427 (AECL–7272) **Gamma-ray irradiation of a boreal forest ecosystem. The field irradiator-gamma (FIG) facility and research programs.** Guthrie, J.E.; Dugle, J.R. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. 1983. 10p. Order Number DE90606459. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

A long-term radiation ecology research project called Field Irradiator - Gamma (FIG) began at the Whiteshell Nuclear Research Establishment in 1968. The experimental area is in southeastern Manitoba and is located on the western edge of the Precambrian shield. The project studies the ecological effects continuous exposure to a gradient of gamma radiation has on a mixed boreal forest ecosystem. The gradient ranges from 1 to 460,000 times the natural background radiation level. This paper describes the forest, the gamma irradiator and its radiation field, and the research program.

53428 (CEGB-RD/B–6112/R89) **Review of the current status of radiation risk estimates.** Charles, M.W.; Little, M.P. Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs. Oct 1988. 62p. Order Number DE90606487. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

This report reviews the current status of radiation risk estimation for low linear energy transfer radiation. Recent statements by various national and international organisations regarding risk estimates are critically discussed. The recently published revised population risk estimates from the study of Japanese bomb survivors are also reviewed and used with some unpublished data from Japan to calculate risk figures for a general work force. (author).

53429 (DOE/ER/60315–1) **Environmental radioactivity from natural, industrial, and military sources: Third edition.** Eisenbud, M. New York Univ., NY (USA). Medical Center. c 1987. 475p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-85ER60315. Order Number DE90000628. Available from NTIS, PC A21/MF A01; OSTI; INIS; GPO Dep.

This document is the third edition of a book generally considered a standard in the field of radioactive materials in the environment. Topics include radiation protection standards, transport mechanisms, terrestrial and aquatic pathways, reprocessing of nuclear fuels, radioactive waste management, the fallout from nuclear explosions, nuclear accidents, and risk assessment. (TEM)

53430 (DOE/ER/60405–4) **Mechanisms of interaction of radiation with matter: Progress report, September 1, 1988–August 31, 1989.** Geacintov, N.E.; Pope, M. New York Univ., NY (USA). Radiation and Solid State Lab. [1989]. 46p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-86ER60405. Order Number DE90001119. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

This progress report is a summary of the research performed. Part I deals with mechanisms of photoemission from organic particulates, theoretical studies of the photoemission of electrons into atmospheres containing scavenger molecules, and theoretical studies of the possible existence of excitonic ions. Particularly noteworthy are our most recent results on the effects of water monolayers on the photoemission of electrons from adenine which show that the emission of electrons may take place over time intervals as long as several tenths of picoseconds after the absorption of a photon. Part II deals with the mechanisms of electrolytic reactions which occur at solid anthracene/aqueous electrolyte interfaces. Part III describes our most recent results on the physico-chemical interactions of mutagenic and carcinogenic polycyclic aromatic hydrocarbon (PAH) derivatives with nucleic acids. Within the last year, we stressed the influence of the structure of the nucleic acid based which are the building blocks of DNA; next year, we plan to investigate the role of the structural parameters of PAH molecules on these interactions which should provide a deeper understanding of the factors which distinguish mutagenic from non-mutagenic compounds. Finally, in Part IV we briefly summarize our project on mechanisms of damage induced by ionizing radiation, and mechanisms of protection from such damage by exogenous molecules. Synthetic oligonucleotides of well defined base composition and sequence, as well as viral supercoiled DNA is being used.

53431 (DOE/ER/60539–T1) **The oncogenic action of ionizing radiation on rat skin: Progress report, February 1, 1987–January 31, 1990.** Burns, F.J.; Garte, S.J. New York Univ., NY (USA). Dept. of Environmental Medicine. [1989]. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER60539. (COO–3380-60). Order Number DE90001535. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Progress is described in three areas corresponding to carcinogenesis and DNA strand breaks in rat skin following exposure by the neon ions or electrons; oncogene activation in radiation-induced rat skin cancers; and DNA strand breaks in the epidermis as a function of radiation penetration. Approximately 200 rats were exposed to the neon ion beam at the Bevalac in Berkeley, CA. The carcinogenicity of energetic electrons (2.0 Mev) was determined for comparison with the neon ion results. For double skin thickness irradiations electrons there was an unusually large excess of connective tissue tumors, fibromas and sarcomas. Presumably the latter tumors are occurring, because more connective tissue is exposed by deeply penetrating, i.e., energetic, beams. 13 refs.

53432 (IAEA-TECDOC–516, pp. 233-256) **Acute effects of radiation exposure following the Chernobyl accident: Immediate results of radiation sickness and outcome of treatment.** Gus'kova, A.K.; Nadezhina, N.M.; Barabanova, A.V.; Baranov, A.E.; Gusev, I.A.; Protasova, T.G.; Boguslavskij, V.B.; Pokrovskaya, V.N. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation Medicine, Kiev (Ukrainian SSR). Jul 1988. (CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

Effect of penetrating radiation evenly distributed over the whole body was the main cause of general clinical syndromes typical for dose range 100-1600 rads (1-16 Gy): bone marrow, intestinal and transitional forms or combinations of these syndromes. According to gamma spectrometry of blood and urine samples and posthumous examination of organs and tissues, max concentrations of iodine-131 in the body were 1-5 mCi (for various patients); for caesium-137 and 134 the figures were 2-2.5 mCi, and contamination by cerium-144 did not exceed 30 mCi (about 95% of cerium activity was in the lungs). Other nuclides did not exceed their MPCs. For personnel on site at the time of the accident, the average exposure dose to the lungs was 0.2 Gy, to the thyroid gland 2.5 Gy, and to the whole body about 0.05 Gy. A whole-body dose of 0.7 Gy may, as a general guide, be regarded as the minimum dose causing insignificant but consistent and individually significant changes in the blood picture characteristic of acute radiation sickness of the first degree. Variant 1 of a diagnostic programme designed to ensure a uniform approach to the diagnosis of first degree acute radiation sickness has been established. Of 21 patients with acute radiation sickness of the third degree (dose range 4-6 Gy), 14 survived. All patients with acute radiation sickness of the fourth degree died except for one. Generally, death resulted from a combination of clinical syndromes, primarily the intestinal and bone marrow syndromes with total or subtotal skin damage. Recovery of haemopoiesis was extremely active: in 84% of cases, the normal blood picture was re-established after 1 to 1 1/2 years. Indicators of fitness for work returned after 8-9 weeks in patients with first and second degree acute radiation sickness and were high one year after exposure. Some who suffered acute radiation sickness are now working at the Chernobyl plant

53433 (IAEA-TECDOC–516, pp. 257-266) **Transplantation of bone marrow in victims of the Chernobyl accident.** Baranov, A.E. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation Medicine, Kiev (Ukrainian SSR). Jul 1988. (CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

Bone marrow transplants were carried out in 13 patients suffering from acute irradiation sickness after the Chernobyl accident. Only blood relations of the patients were used as donors. The number of bone marrow cells transplanted must be at least $2x10^8$ per kilogram of recipient weight. The experience of the present bone marrow transplants has shown defects in clinical methods of early diagnosis (during the first 7-10 days after exposure) of acute radiation injuries to the skin, intestine and lungs which are incompatible with survival. Another problem with bone marrow transplants for patients suffering from acute radiation sickness is to determine to what extent the depression of marrow activity is irreversible. Spontaneous regeneration of myelopoiesis was observed 22-30 days after exposure in patients who had received doses of 7-9 Gy. A lapse of this order before the onset regeneration is therefore, in principle, compatible with survival under the conditions of modern support therapy. Thus, the belief that prolonged acute radiation pancytopenia which is incompatible with survival starts already at doses of 5-6 Gy is evidently incorrect, at least for the relatively low exposure dose rates experienced by this group of victims. The results of bone marrow transplants in victims of the Chernobyl accident suggest that, in future, the following rules should be observed in transplanting human bone marrow to victims of acute radiation sickness: (1) Only HLA-identical transplants should be carried out; and (2) HLA-identical bone marrow transplants should be carried out only in patients who have received whole body doses of gamma radiation of 9.0 Gy or more. (author). 1 tab.

53434 (IAEA-TECDOC–516, pp. 267-272) **Rehabilitation of victims of acute radiation sickness.** Bebeshko, V.G.; Prevarskij,

B.P.; Khalyavko, I.G.; Shimelis, I.V.; Belyj, D.A. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation Medicine, Kiev (Ukrainian SSR). Jul 1988. (CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

Two hundred and nine victims of acute radiation sickness following the Chernobyl accident are under observation (first degree - 134, second degree - 54, third degree - 20 and fourth degree - 1). In 57 (42.5%) of the patients having suffered first degree acute radiation sickness, work capability was reduced by 25%; 9 persons with first degree acute radiation sickness were classified as invalids of the second and third category. In the group with second degree acute radiation sickness, a reduction of the work capability was observed in all cases. In the group with third degree, 100% had signs of disability. In carrying out rehabilitation and prophylactic measures aimed at reducing social risk factors, considerable attention has been given to publicizing a healthy way of life. At present, professional reorientation has been or is being given to the majority of patients. An analysis of the results of rehabilitation measures carried out during the year shows a gradual improvement in general health and an improvement in working capabilities. However, the symptomatology of injuries to individual organs and systems remains unchanged. (author). 1 tab.

53435 (IAEA-TECDOC–516, pp. 273-281) **Problems of evaluating public health after an accident at a nuclear power plant.** Pyatak, O.A.; Luk'yanova, E.M.; Bugaev, V.N. and others. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation Medicine, Kiev (Ukrainian SSR). Jul 1988. (CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

The Chernobyl accident caused, in addition to external exposure to radiation, inhalation and oral intake of the main dose-forming radionuclides: caesium-134 and 137 and iodine-131. Taken together, the adverse factors emerging from the accident at Chernobyl manifested themselves first and foremost in vegetative dysfunction, disturbances of neurovascular regulation and changes in the reactivity of the immune system. The significantly increasing migration of the population and its inhomogeneous nature, especially in the groups of reproductive age, are bringing about changes in the structure of the population and in family planning strategies. In the regions studied, dynamic statistical indicators of the spread of infectious diseases have reflected the general trend in our country, namely towards a reduction of such diseases. In 1986, the frequency of acute intestinal infection dropped in a number of regions by factors of 1.5-8. In the Ukraine a special clinical register of pregnant women and babies from the regions under study is being kept. The initial document includes 1,630 pregnant women. No significant departures from the norm have been found in the course of these pregnancies and births, or in the condition of the new-born babies. Detailed clinical examination of 416 babies showed that the condition of the vast majority of them at birth corresponded to a score of 7-8 on the Apgar scale. Examination of the reproductive system in 417 women of child-bearing age did not reveal any abnormalities. We are now at the beginning of a second observation period, associated with the development of somatic stochastic effects. It will be necessary to carry out further retrospective and prospective analyses of the incidence of disease in various population groups, taking into account age, sex and profession, as well as medical, social, geographical, ecological and other factors affecting the organism. (author).

53436 (IAEA-TECDOC–516, pp. 293-298) **State of the pituitary and thyroid system in children at various times after exposure to radiation as a result of the Chernobyl accident.** Benikova, E.A.; Bol'shova, E.V.; Zvonova, I.A. and others. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation Medicine, Kiev (Ukrainian SSR). Jul 1988. (CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

A clinical/laboratory examination was made of children from the age of 1-14 years from the area of high radiation. The examination was carried out on a continuous basis, beginning in the first half of May 1986 and is still in progress. At no stage was there any clinical evidence of thyroid dysfunction, but, in a significant proportion of the children an increase in the size of the thyroid gland was noted. In May and June 1986, 77.5% of the children had a first or second degree enlargement of the thyroid gland. At the same time, there was an increase in the level of T_4 in the blood: 85.20 +- 7.36 nmole/L to 348.33 +- 38.26 nmole/L. In the subsequent stages, a gradual normalization of these parameters was noted. No other significant functional or organic disorders of the pituitary-thyroid system were detected. (author).

53437 (IAEA-TECDOC–516, pp. 299-307) **Medical care during the radiation accident (^{137}Cs) in Brazil, 1987.** Selidovkin, G.D. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation Medicine, Kiev (Ukrainian SSR). Jul 1988. (CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

The report describes the activities of diagnosis, prognosis and treatment of overexposed individuals during the radiological accident of Goiania in Brazil. In particular it describes the handling of 17 individuals who suffered acute radiation syndromes. After summarizing the development of the accident the report describes the radiation injuries of people, the biological dosimetry methods used for the diagnosis of doses and the methods for decontamination. The treatment and the response of the patients is also described in detail. (author).

53438 (IAEA-TECDOC–516, pp. 345-350) **Preparation of an all-union distribution register of persons exposed to the effects of radiation as a result of the Chernobyl accident, with a view to evaluating exposure doses and making a long term public health forecast.** Tsyb, A.F.; Dedenkov, A.N.; Ivanov, V.K. and others. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation Medicine, Kiev (Ukrainian SSR). Jul 1988. (CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

The all-Union distribution register is a multilevel information and control system covering almost all parts of the country. This register is to be kept for many decades: it is a large-scale project of great significance for the selection of strategies and tactics for the development of nuclear power, for the use of ionizing radiations in the economy, and for effective and complete solutions to radiation safety problems. Smooth and well-co-ordinated work by all specialists and organizations involved in its preparation is therefore essential. (author).

53439 (IAEA-TECDOC–516, pp. 351-364) **Organization and planning of work involved in the long term clinical observation of children with a high radiation risk.** Bugaev, V.N.; Bomko, E.I.; Bruslova, E.M.; Avramenko, A.I.; Buldakov, L.A.; Rubel, N.F. International Atomic Energy Agency, Vienna (Austria); Ministerstvo Zdravookhraneniya SSSR, Moscow (USSR); All-Union Scientific Centre of Radiation Medicine, Kiev (Ukrainian SSR). Jul 1988.

(CONF-8805334–: All-Union conference on medical aspects of the Chernobyl accident, Kiev (Ukrainian SSR), 11-13 May 1988). In *Medical aspects of the Chernobyl accident. Proceedings of an all-union conference held in Kiev, 11-13 May 1988.* Order Number DE90604939. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

Operation of the register involves analysing the basic parameters characterizing the health of children, carrying out epidemiological studies on various types of disease, refining dose parameters and reconstructing actual doses, establishing spatial and temporal dose distribution patterns, providing systematic information in support of the register, and so on. By 16 May 1986, thyroid dose monitoring had been carried out and detailed blood analyses performed on 140,000 children, who were also given complete medical examinations by specialists. In 95% of these children, the calculated caesium intake at the end of the year following the accident was less than 1 rem. Further information support for the register of the child population with the same comprehensive volume of medical information will make it possible to study the teratogenic effects of ionizing radiation and abnormal growth and development of children exposed at an early age, and to determine risk coefficients as a function of time, teratogenesis and cancer of the more sensitive tissues, as well as the effects of small doses of ionizing radiation. (author). 6 figs.

53440 (INIS-SU–116/A) **Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.** Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. 134p. (In Russian). (CONF-8806200–: International Atomic Energy Authority meeting on sodium fires, Obninsk (USSR), 6-7 Jun 1988). Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02620.

This document contains the proceedings of the All-union Conference of on Local Radiation Damage due to Diagnostic or Therapeutic Radiation held in Obninsk on June 28-29, 1988.

53441 (INIS-SU–116/A, pp. 26-28) **Delayed radiation injuries in oncogynecology.** Artamonova, N.O. (Khar'kovskij Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii, Kharkov (Ukrainian SSR)); Kislichenko, V.A.; Busygina, N.A. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02620.

Short note. RADIOTHERAPY/delayed radiation effects; RADIOTHERAPY/side effects; CARCINOMAS; GASTROINTESTINAL TRACT; INTEGRAL DOSES; OPTIMIZATION; PATIENTS; PLANNING; RADIOTHERAPY; URINARY TRACT; UROGENITAL SYSTEM DISEASES

53442 (INIS-SU–116/A, pp. 25) **Modification of radiation skin injuries resulted from fast neutrons irradiation.** Letov, V.N. (Akademiya Meditsinskikh Nauk SSSR, Tomsk (USSR). Onkologicheskij Nauchnyj Tsentr); Averin, S.A.; Modyaev, V.P. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02620.

Short note. RADIODERMATITIS/ointments; RADIODERMATITIS/post-irradiation therapy; RADIOTHERAPY/side effects; FAST NEUTRONS; MICE; PATIENTS; RADIODERMATITIS; OINTMENTS; RADIOTHERAPY; RESPONSE MODIFYING FACTORS; SKIN

53443 (INIS-SU–116/A, pp. 16-17) **Delayed injuries of healthy tissues in case of various types of conservative treatment of neoplasms of nasal, oral and pharyngeal.** Aliev, B.M. (Akademiya Meditsinskikh Nauk SSSR, Moscow (USSR). Onkologicheskij Nauchnyj Tsentr); Chuprik-Malinovskaya, T.P.; Koshaliev, Eh.Sh.; Aleknavichyus, Eh.Eh.; Choudkhuri, F.A. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

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Short note. RADIOTHERAPY/delayed radiation effects; RADIOTHERAPY/side effects; BIOLOGICAL LOCALIZATION; CHEMOTHERAPY; INTEGRAL DOSES; NEOPLASMS; NOSE; ORAL CAVITY; PATIENTS; PHARYNX; RADIOTHERAPY

53444 (INIS-SU–116/A, pp. 13-15) **Delayed radiation injuries of maxillofacial area.** Vorob'ev, Yu.I. (Moskovskij Meditsinskij Stomatologicheskij Inst., Moscow (USSR)). Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

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Short note. RADIOTHERAPY/delayed radiation effects; RADIOTHERAPY/side effects; BIOLOGICAL LOCALIZATION; INTEGRAL DOSES; JAW; NEOPLASMS; PATIENTS; RADIOTHERAPY; TEETH

53445 (INIS-SU–116/A, pp. 11-13) **Characteristic of frequency of delayed injuries following radiotherapy according to native and foreign data.** Artamonova, N.I. (Khar'kovskij Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii, Kharkov (Ukrainian SSR)); Kinoshenko, Yu.T.; Busygina, N.A. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

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Short note. RADIOTHERAPY/delayed radiation effects; RADIOTHERAPY/side effects; BIOLOGICAL LOCALIZATION; NEOPLASMS; OPTIMIZATION; PATIENTS; PLANNING; RADIOTHERAPY

53446 (INIS-SU–116/A, pp. 3-11) **Local radiation injuries and their classification.** Bardychev, M.S. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

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Short note. 1 tab. RADIOTHERAPY/radiation injuries; RADIOTHERAPY/side effects; NEOPLASMS; ORGANS; PATIENTS; RADIOTHERAPY

53447 (INIS-SU–116/A, pp. 28-29) **Peculiarities of radiation response and complications in radiation treatment of cervix uteri carcinoma using large dose fractionation at Agat-B device.** Kolesnikova, V.A. (Rostovskij-na-Donu Nauchno-Issledovatel'skij Onkologicheskij Inst., Rostov-na-Donu (USSR)); Rozenko, L.Ya.; Brazhnikova, E.I.; Levitskij, A.A. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.*

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Short note. RADIOTHERAPY/side effects; CARCINOMAS; DOSE-RESPONSE RELATIONSHIPS; FEMALE GENITALS; FRACTIONATED IRRADIATION; PATIENTS; RADIOTHERAPY; RECTUM; URINARY TRACT; UROGENITAL SYSTEM DISEASES

53448 (INIS-SU–116/A, pp. 30-31) **Prophylaxis of severe rectum radiation injuries in patients with cervix uteri carcinoma.** Gorozhankina, G.S. (Kirgizskij Nauchno-Issledovatel'skij Inst. Onkologii i Radiologii, Frunze (USSR)). Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
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Short note. RADIOTHERAPY/side effects; RECTUM/radiation injuries; BIOLOGICAL LOCALIZATION; CARCINOMAS; OPTIMIZATION; PATIENTS; RADIOTHERAPY; RECTUM; UROGENITAL SYSTEM DISEASES

53449 (INIS-SU–116/A, pp. 40-42) **Delayed radiation intrapelvic fibrosis.** Kiseleva, M.V. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
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Short note. FIBROSIS/radiation injuries; RADIOTHERAPY/side effects; BIOLOGICAL FUNCTIONS; CARCINOMAS; DMSO; FIBROSIS; PATIENTS; POST-IRRADIATION THERAPY; RADIOTHERAPY; RECTUM; URINARY TRACT; UROGENITAL SYSTEM DISEASES

53450 (INIS-SU–116/A, pp. 42-43) **Radiation injuries of small pelvs organs and tissues in treatment of vagina rhabdomyosarcomas in children.** Nechushkina, I.V. (Akademiya Meditsinskikh Nauk SSSR, Moscow (USSR). Onkologicheskij Nauchnyj Tsentr); Nechushkin, M.I.; Kiseleva, V.N.; Bukhny, A.F.; Likhovetskaya, R.B. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
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Short note. PELVIS/radiation injuries; RADIOTHERAPY/side effects; CHILDREN; FEMALE GENITALS; INTEGRAL DOSES; PATIENTS; PELVIS; RADIOTHERAPY; RECTUM; RHABDOMYOSARCOMAS; URINARY TRACT

53451 (INIS-SU–116/A, pp. 45-46) **Analysis of lung injuries following radiation treatment of lung cancer.** Litvinov, P.D. (Tsentral'nyj Nauchno-Issledovatel'skij Rentgeno-Radiologicheskij Inst., Leningrad (USSR)); Mus, V.F.; Kuznetsov, K.O. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
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Short note. RADIOTHERAPY/side effects; RESPIRATORY SYSTEM DISEASES/radiation injuries; CARCINOMAS; DELAYED RADIATION EFFECTS; EARLY RADIATION EFFECTS; ERYTHEMA; FIBROSIS; INTEGRAL DOSES; LUNGS; PATIENTS; RADIOTHERAPY

53452 (INIS-SU–116/A, pp. 46-48) **Radiation complications following interstitial and combined radiotherapy of tongue and oral cavity neoplasm.** Matyakin, G.G. (Akademiya Meditsinskikh Nauk SSSR, Moscow (USSR). Onkologicheskij Nauchnyj Tsentr); Androsov, N.S.; Bocharova, V.A. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
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Short note. RADIOTHERAPY/side effects; BIOLOGICAL RADIATION EFFECTS; INTEGRAL DOSES; NEOPLASMS; ORAL CAVITY; PATIENTS; RADIOTHERAPY; TONGUE

53453 (INIS-SU–116/A, pp. 49-50) **Delayed local complications following radiotherapy of disseminated pharynx neoplasm and their treatment.** Puchinina, E.A. (Nauchno-Issledovatel'skij Inst. Onkologii i Meditsinskoj Radiologii, Minsk (Byelorussian SSR)); Vakker, A.V. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
TB-02620.
Short note. RADIOTHERAPY/delayed radiation effects; LARYNX; PATIENTS; PHARYNX; POST-IRRADIATION THERAPY; RADIOTHERAPY; SIDE EFFECTS

53454 (INIS-SU–116/A, pp. 50-52) **Radiation injuries of the pharynx.** Vakker, A.V. (Nauchno-Issledovatel'skij Inst. Onkologii i Meditsinskoj Radiologii, Minsk (Byelorussian SSR)). Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
TB-02620.
Short note. PHARYNX/radiation injuries; RADIOTHERAPY/side effects; DELAYED RADIATION EFFECTS; INTEGRAL DOSES; PATIENTS; PHARYNX; RADIOTHERAPY; RESPONSE MODIFYING FACTORS

53455 (INIS-SU–116/A, pp. 55-56) **Delayed radiation injuries in case of use modifying factors in Hodgkin's disease treatment.** Aliev, B.M. (Akademiya Meditsinskikh Nauk SSSR, Moscow (USSR). Onkologicheskij Nauchnyj Tsentr); Vasygova, N.F.; Yur'eva, Yu.V.; Aralbaev, R.T. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
TB-02620.
Short note. HODGKINS DISEASE/delayed radiation effects; HODGKINS DISEASE/response modifying factors; INTEGRAL DOSES; PATIENTS; RADIOTHERAPY; SIDE EFFECTS

53456 (INIS-SU–116/A, pp. 56-58) **Delayed radiation injuries following repeated irradiation of pelvis and femur in the regime of medium fractionation.** Monzul', G.D. (Akademiya Meditsinskikh Nauk SSSR, Moscow (USSR). Onkologicheskij Nauchnyj Tsentr); Ratner, T.G. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation*

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Short note. RADIOTHERAPY/delayed radiation effects; FEMUR; INTEGRAL DOSES; MAMMARY GLANDS; METASTASES; NEOPLASMS; PATIENTS; PELVIS; RADIOTHERAPY

53457 (INIS-SU–116/A, pp. 58-60) **Radiation complications following Ewing sarcoma of long tubular bones in children and adolescents.** Timukhina, V.N.; Bizer, V.A. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
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Short note. RADIOTHERAPY/delayed radiation effects; RADIOTHERAPY/side effects; ADOLESCENTS; BIOLOGICAL LOCALIZATION; BONE TISSUES; CHILDREN; INTEGRAL DOSES; PATIENTS; RADIOTHERAPY; SARCOMAS

53458 (INIS-SU–116/A, pp. 60-63) **Assessment of severity of delayed skin radiation injuries following acute local irradiation according to dosimetric data.** Kharchenko, L.P. (Institut Biofiziki, Moscow (USSR)). Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
TB-02620.
Short note. 1 tab. RADIOTHERAPY/delayed radiation effects; RADIOTHERAPY/dosimetry; SKIN/radiation injuries; PATIENTS; RADIOTHERAPY; DOSIMETRY; SKIN

53459 (INIS-SU–116/A, pp. 68-70) **Assessment of factors change of rheovasogram before and after conservative treatment in patients with secondary (radiation) edema of upper limbs.** Korobchenko, Z.A.; Khmelevskaya, N.A.; Zubova, N.D. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
TB-02620.
Short note. RADIATION INJURIES/biomedical radiography; RADIOTHERAPY/side effects; ARMS; BLOOD VESSELS; EDEMA; IMAGES; MAMMARY GLANDS; NEOPLASMS; PATIENTS; RADIOTHERAPY

53460 (INIS-SU–116/A, pp. 70-73) **Functional state of cardiovascular system at delayed periods following radio- and chemotherapy.** Tovarushkin, V.I.; Astapov, B.M.; Giseva, Z.A. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
TB-02620.
Short note. HEART/biomedical radiography; RADIOTHERAPY/side effects; BIOLOGICAL FUNCTIONS; CARDIOGRAPHY; CARDIOVASCULAR DISEASES; CHEMOTHERAPY; HEART; INTEGRAL DOSES; PATIENTS; RADIOTHERAPY; ULTRASONIC WAVES

53461 (INIS-SU–116/A, pp. 66-68) **Treatment of rectovaginal fistulae following radiation treatment of uterine and cervix uteri carcinoma.** Berdov, B.A.; Abramyan, S.G. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
TB-02620.
Short note. FISTULAE/post-irradiation therapy; RADIATION INJURIES/fistulae; RADIOTHERAPY/side effects; CARCINOMAS; FISTULAE; PATIENTS; RADIOTHERAPY; UROGENITAL SYSTEM DISEASES

53462 (INIS-SU–116/A, pp. 73-76) **Delayed radiation pericarditis.** Astapov, B.M.; Yuzhakova, M.Z. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
TB-02620.
Short note. RADIOTHERAPY/delayed radiation effects; RADIOTHERAPY/side effects; CARDIOGRAPHY; CARDIOVASCULAR DISEASES; HEART; NEOPLASMS; PATIENTS; RADIOTHERAPY

53463 (INIS-SU–116/A, pp. 80) **Radiation fibroses and pulmonitises in patients with Hodgkin's disease of 3-d stage in various fractionation regimes.** Il'in, N.V. (Tsentral'nyj Nauchno-Issledovatel'skij Rentgeno-Radiologicheskij Inst., Leningrad (USSR)); Korytova, L.I.; Semich, V.N.; Lovyagin, E.V.; Kaganskij, V.L.; Grosheva, E.V. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
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Short note. RADIOTHERAPY/side effects; DELAYED RADIATION EFFECTS; HODGKINS DISEASE; LUNGS; PATIENTS; RADIOTHERAPY; RESPIRATORY SYSTEM DISEASES

53464 (INIS-SU–116/A, pp. 76-79) **Delayed lung radiation injuries following radiation treatment of mammary gland cancer.** Zorina, L.A.; Kuz'mina, N.S.; Romagin, V.K.; Khmelevskaya, N.A. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
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Short note. RADIATION INJURIES/lungs; RADIOTHERAPY/side effects; CHEMOTHERAPY; DELAYED RADIATION EFFECTS; MAMMARY GLANDS; NEOPLASMS; PATIENTS; LUNGS; RADIOTHERAPY

53465 (INIS-SU–116/A, pp. 81-82) **Examination of nervous-muscular system and peripheral blood circulation in patients radically treated in case of mammary gland cancer.** Gundareva, I.D. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
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Short note. RADIOTHERAPY/side effects; BLOOD CIRCULATION; INTEGRAL DOSES; MAMMARY GLANDS; MUSCLES; NEOPLASMS; NERVES; PATIENTS; RADIOTHERAPY

53466 (INIS-SU–116/A, pp. 83-84) **Dynamics of rheological blood properties in patients with radiation edema of upper limbs in the course of conservative treatment.** Timchenko, V.G. (Khar'kovskij Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii, Kharkov (Ukrainian SSR)); Moroz, V.A.; Shapovalov, S.V. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

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Short note. BLOOD PLASMA/radiation injuries; RADIOTHERAPY/side effects; ARMS; EDEMA; MAMMARY GLANDS; NEOPLASMS; PATIENTS; RADIOTHERAPY

53467 (INIS-SU–116/A, pp. 84-86) **Complex clinico-biochemical assessment of development of delayed radiation injuries of connective tissue.** Frenkel', L.A. (Khar'kovskij Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii, Kharkov (Ukrainian SSR)); Uzlenkova, N.E.; Beketova, S.N.; Gajsenyuk, L.A. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

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Short note. RADIATION INJURIES/connective tissue; RADIOTHERAPY/side effects; BIOCHEMISTRY; BONE TISSUES; DELAYED RADIATION EFFECTS; PATIENTS; RADIOTHERAPY; SKIN

53468 (INIS-SU–116/A, pp. 89-90) **Radiodiagnosis of lymph flow disturbances in patients with delayed radiation injuries of soft tissues.** Moroz, V.A. (Khar'kovskij Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii, Kharkov (Ukrainian SSR)). Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

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Short note. LYMPHATIC SYSTEM/radiation injuries; RADIOTHERAPY/side effects; BIOMEDICAL RADIOGRAPHY; DELAYED RADIATION EFFECTS; PATIENTS; RADIOTHERAPY; TISSUES

53469 (INIS-SU–116/A, pp. 90-93) **Radiodiagnosis of radiation injuries of limb bones in adults.** Gun'ko, R.I. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

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Short note. DIAGNOSIS/radiation injuries; RADIOTHERAPY/side effects; ADULTS; BIOMEDICAL RADIOGRAPHY; BONE FRACTURES; DIAGNOSIS; INTEGRAL DOSES; LIMBS; NECROSIS; NEOPLASMS; OSTEOMYELITIS; OSTEOPOROSIS; PATIENTS; RADIOTHERAPY

53470 (INIS-SU–116/A, pp. 93-95) **Angiogenic periostosis of crus bones following radiotherapy of skin melanoma.** Gun'ko, R.I.; Krasnov, A.S. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

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Short note. RADIATION INJURIES/skeleton; RADIOTHERAPY/side effects; BIOMEDICAL RADIOGRAPHY; BLOOD VESSELS; FRACTIONATED IRRADIATION; INTEGRAL DOSES; MELANOMAS; PATIENTS; SKELETON; RADIOTHERAPY; SKIN; X RADIATION

53471 (INIS-SU–116/A, pp. 95-96) **Radiation injuries of vertebrae in esophagus cancer treatment.** Gerasimyak, V.G. (Tsentral'nyj Nauchno-Issledovatel'skij Rentgeno-Radiologicheskij Inst., Leningrad (USSR)). Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02620.

Short note. RADIATION INJURIES/vertebrae; RADIOTHERAPY/side effects; BIOMEDICAL RADIOGRAPHY; ESOPHAGUS; INTEGRAL DOSES; NEOPLASMS; PATIENTS; VERTEBRAE; RADIOTHERAPY

53472 (INIS-SU–116/A, pp. 97-99) **Dimexide (dmso) for prophylaxis and treatment of local radiation injuries.** Bardychev, M.S. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02620.

Short note. DMSO/radiation injuries; RADIOTHERAPY/side effects; DMSO; PATIENTS; RADIOTHERAPY; SKIN

53473 (INIS-SU–116/A, pp. 99-101) **Treatment of radiation ulcers of skin and adjacent soft tissues in controlled abactrial medium.** Kim, Yu.A. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02620.

Short note. RADIATION INJURIES/ulcers; RADIOTHERAPY/side effects; ALBUMINS; DELAYED RADIATION EFFECTS; GAMMA RADIATION; IODINE 131; MICROORGANISMS; PATIENTS; ULCERS; RADIOPHARMACEUTICALS; RADIOTHERAPY; SKIN; TISSUES; X RADIATION

53474 (INIS-SU–116/A, pp. 101-103) **Local radiation injuries.** Savinykh, L.M. (Uzbekskij Nauchno-Issledovatel'skij Inst. Onkologii i Radiologii, Tashkent (USSR)). Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02620.

Short note. RADIATION INJURIES/skin; RADIOTHERAPY/delayed radiation effects; RADIOTHERAPY/side effects; BIOMEDICAL RADIOGRAPHY; GAMMA RADIATION; INTEGRAL DOSES; PATIENTS; SKIN; RADIOTHERAPY; X RADIATION

53475 (INIS-SU–116/A, pp. 103-104) **Microsurgical autoplastictransplantation of greater omentum for plasty of radiation injuries of integmentary tissues.** Milanov, N.O. (Akademiya Meditsinskikh Nauk SSSR, Moscow (USSR). Vsesoyuznyj Nauchnyj Tsentr Khirurgii); Bardychev, M.S.; Shilov, B.L. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst.

Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02620.

Short note. 1 tab. RADIATION INJURIES/plastic surgery; RADIATION INJURIES/transplants; RADIOTHERAPY/side effects; BIOLOGICAL LOCALIZATION; MESENTERY; NEOPLASMS; PATIENTS; TRANSPLANTS; RADIOTHERAPY; ULCERS

53476 (INIS-SU–116/A, pp. 105-107) **Treatment of delayed radiation injuries of lungs.** Zorina, L.A. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02620.

Short note. RADIATION INJURIES/chemotherapy; RADIATION INJURIES/post-irradiation therapy; RADIOTHERAPY/side effects; DELAYED RADIATION EFFECTS; DRUGS; FIBROSIS; LUNGS; PATIENTS; CHEMOTHERAPY; RADIOTHERAPY

53477 (INIS-SU–116/A, pp. 107-109) **Treatment of operative wounds because of breast cancer with preoperative radiotherapy.** Shamilov, A.K. (Akademiya Meditsinskikh Nauk SSSR, Moscow (USSR). Onkologicheskij Nauchnyj Tsentr); Dmuzhakulyeva, S.I.; Nechushkin, M.I.; Tsikhiseli, G.R. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02620.

Short note. RADIOTHERAPY/side effects; ENZYMES; FRACTIONATED IRRADIATION; INTEGRAL DOSES; MAMMARY GLANDS; NEOPLASMS; PATIENTS; RADIOTHERAPY; SURGERY

53478 (INIS-SU–116/A, pp. 109-111) **Use of cozilat preparation as enteral nutrition for patients with late radiation injuries of colon.** Artamonov, Yu.I.; Kurpesheva, A.K. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02620.

Short note. RADIATION INJURIES/large intestine; RADIOTHERAPY/side effects; CARCINOMAS; DRUGS; INTEGRAL DOSES; NUTRITION; PATIENTS; RADIOTHERAPY; UROGENITAL SYSTEM DISEASES

53479 (INIS-SU–116/A, pp. 111-113) **Treatment results of colon radiation ulcers.** Kholin, V.V. (Tsentral'nyj Nauchno-Issledovatel'skij Rentgeno-Radiologicheskij Inst., Leningrad (USSR)); Lubenets, Eh.N.; Vinokurov, V.L. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02620.

Short note. 1 tab. RADIATION INJURIES/large intestine; RADIOTHERAPY/side effects; CARCINOMAS; CHEMOTHERAPY; DRUGS; PATIENTS; RADIOTHERAPY; ULCERS; UROGENITAL SYSTEM DISEASES

53480 (INIS-SU–116/A, pp. 113-115) **Peculiarities of course and treatment of radiation cystitis in the process of concominatant radiotherapy including intracavitary gamma-therapy at Agat-B unit in patients with cevrix uteri carcinoma.** Vishnevskaya, E.E. (Nauchno-Issledovatel'skij Inst. Onkologii i Meditsinskoj Radiologii, Minsk (Byelorussian SSR)). Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02620.

Short note. RADIATION INJURIES/bladder; RADIOTHERAPY/side effects; CARCINOMAS; GAMMA RADIATION; IRRADIATION DEVICES; PATIENTS; BLADDER; RADIOTHERAPY; UROGENITAL SYSTEM DISEASES

53481 (INIS-SU–116/A, pp. 115-117) **Lazer puncture in combined treatment of secondary (radiation) edema of upper limbs.** Degtyareva, A.A.; Kuz'mina, E.G.; Evtifeeva, E.S. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02620.

Short note. RADIATION INJURIES/edema; RADIATION INJURIES/limbs; RADIOTHERAPY/side effects; LASER RADIATION; MAMMARY GLANDS; NEOPLASMS; PATIENTS; POST-IRRADIATION THERAPY; EDEMA; LIMBS; RADIOTHERAPY

53482 (INIS-SU–116/A, pp. 117-118) **Reflex therapy in treatment of secondary (radiation) neurologic disorders.** Zubova, N.D. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02620.

Short note. RADIATION INJURIES/nervous system diseases; RADIOTHERAPY/side effects; BIOLOGICAL LOCALIZATION; FRACTIONATED IRRADIATION; INTEGRAL DOSES; NEOPLASMS; PATIENTS; RADIOTHERAPY; REFLEXES

53483 (INIS-SU–116/A, pp. 119-121) **Immune indices and common protein in interstitial fluid as evaluation of treatment effect of patients with secondary (radiation) edema of limbs using laser puncture.** Kuz'mina, E.G.; Degtyareva, A.A.; Rogova, N.M.; Doroshenko, L.N. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

TB-02620.

Short note. RADIATION INJURIES/edema; RADIOTHERAPY/side effects; BODY FLUIDS; CHEMOTHERAPY; DELAYED RADIATION EFFECTS; FIBROSIS; IMMUNOGLOBULINS; LASER RADIATION; MAMMARY GLANDS; NEOPLASMS; PATIENTS; EDEMA; RADIOTHERAPY

53484 (INIS-SU–116/A, pp. 121-123) **Experience on electropuncture application in treatment of late radiation ulcers.** Khenkin, E.V. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation*

injuries. Summaries of reports. Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
TB-02620.
Short note. RADIATION INJURIES/ulcers; RADIOTHERAPY/side effects; DELAYED RADIATION EFFECTS; ELECTRIC CURRENTS; NEOPLASMS; PATIENTS; ULCERS; RADIOTHERAPY

53485 (INIS-SU–116/A, pp. 123-124) **Laser therapy in treatment of radiation injuries in children with malignant tumors of head and neck.** Lobanov, G.V. (Akademiya Meditsinskikh Nauk SSSR, Moscow (USSR). Onkologicheskij Nauchnyj Tsentr); Polyakov, V.G. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
TB-02620.
Short note. RADIATION INJURIES/head; RADIATION INJURIES/neck; RADIOTHERAPY/side effects; CHILDREN; LASER RADIATION; PATIENTS; POST-IRRADIATION THERAPY; HEAD; NECK; RADIOTHERAPY; RHABDOMYOSARCOMAS

53486 (INIS-SU–116/A, pp. 124-126) **Radiation injuries of exterior genital organs.** Kiseleva, M.V.; Petrik, V.D. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
TB-02620.
Short note. RADIATION INJURIES/ulcers; RADIOTHERAPY/side effects; CHEMOTHERAPY; FEMALE GENITALS; FRACTIONATED IRRADIATION; INTEGRAL DOSES; MALE GENITALS; NEOPLASMS; PATIENTS; ULCERS; RADIOTHERAPY; SURGERY

53487 (INIS-SU–116/A, pp. 126-127) **Caprofer for treatment of burns complicated with radiation pathology.** Shakhnazaryan, Eh.L.; Papoyan, S.A.; Oganesyan, R.K.; Aleksanyan, A.Z. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
TB-02620.
Short note. RADIATION BURNS/post-irradiation therapy; RADIATION BURNS/radiation syndrome; CHEMOTHERAPY; DRUGS; GAMMA RADIATION; RADIATION DOSES; RATS

53488 (INIS-SU–116/A, pp. 127-129) **Radiation injuries of gastrointestinal in patients with Hogdkin disease.** Shcherbenko, O.I. (Nauchno-Issledovatel'skij Inst. Rentgenologii i Radiologii, Moscow (USSR)); Pelikh, S.T.; Pan'shin, G.A.; Galil-Ogly, G.A. Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii. 1988. (In Russian). (CONF-8806432–: All-Union conference on local radiation damage diagnostics and treatment, Obninsk (USSR), 28-29 Jun 1988). In *Diagnosis and treatment of local delayed radiation injuries. Summaries of reports.* Order Number DE90705925. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
TB-02620.
Short note. RADIATION INJURIES/gastrointestinal tract; RADIOTHERAPY/side effects; HODGKINS DISEASE; MUCOUS MEMBRANES; PATIENTS; RADIOTHERAPY

53489 (INIS-SU–131/A, pp. 98-106) **Functioning of spontaneous and induced Con A regulators of T-cell proliferation. Modifying factors.** Kuz'mina, E.G. Akademiya Meditsinskikh Nauk SSSR, Moscow (USSR); Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii, Obninsk (USSR). 1989. (In Russian). In *Interferon inductors and other immunomodulators in radiology and oncology. Scientific reports collection.* Order Number DE90705924. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
TB-02943.
It is shown that active spontaneous non-specific regulators of T-cell proliferation are activated in peripheral blood "in vivo" by endogenous metabolites; non-specific regulator action can be induced "in vitro" by concavelin A, FGA. Non-specific regulators suppress and increase lymphocyte proliferation. Cyclic character of their functioning is revealed. 4 refs.; 1 tab.

53490 (INIS-SU–131/A, pp. 24-28) **Modification of radiation reaction of neoplasms by inductors of interferon synthesis.** Pelevina, I.I. (AN SSSR, Moscow (USSR). Inst. Khimicheskoj Fiziki); Ershov, F.I.; Chizhov, Ya.I. and others. Akademiya Meditsinskikh Nauk SSSR, Moscow (USSR); Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii, Obninsk (USSR). 1989. (In Russian). In *Interferon inductors and other immunomodulators in radiology and oncology. Scientific reports collection.* Order Number DE90705924. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
TB-02943.
Combined action of interferon synthesis inductors with irradiation chemotherapeutic preparations, radiosensitizing agents is studied. It is shown that all interferon synthesis inductors tested did not cause any substantial retardation of transplanted neoplasms even in little mice; under combined action with irradiation they increase neoplasm irradiation efficiency. It is ascertained that the given effect is observed in animals at the background of high interferon titers in blood serum, caused by inductors, and at the background of high interferon titers in neoplasms which exists there initially. It is assumed that data on interferon titers are not information content to judge about interferon synthesis inductor efficiency.

53491 (INIS-SU–131/A, pp. 28-35) **Peculiarities of neoplasm reaction in case of combined effect of interferon synthesis inductors and radiation.** Olejnikova, O.M.; Fedorovskaya, E.O. Akademiya Meditsinskikh Nauk SSSR, Moscow (USSR); Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii, Obninsk (USSR). 1989. (In Russian). In *Interferon inductors and other immunomodulators in radiology and oncology. Scientific reports collection.* Order Number DE90705924. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
TB-02943.
Autitumoral antimetastatic effect of certain interferon synthesis inductors of various classes are studied including poly I, poly Ts, tyloron, curantyl in combination with irradiation using sarcoma-37 and Lewis carcinoma models. When investigating different synthetic interferon synthesis inductors differing by synthesis terms and endogenous interferon titers, an insulficient radiosensitizing effet on sarcoma-37 tumor is detected. The most obvious effect of the same inductors was observed in Lewis carcinoma: the number of secondary tumors (metastases) is 2.0-2.5 times reduced when the inductor is injected a day before irradiation. 11 refs.; 4 tabs.

53492 (INIS-SU–131/A, pp. 52-57) **Effect of sodium nucleinate on antibody formation in irradiated animals tumor-carriers.** Karpova, N.A.; Surinov, B.P. Akademiya Meditsinskikh Nauk SSSR, Moscow (USSR); Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii, Obninsk (USSR). 1989. (In Russian). In *Interferon inductors and other immunomodulators in radiology and oncology. Scientific reports collection.* Order Number DE90705924. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
TB-02943.
Effect of sodium nucleinate on antibody formation in mice at different stages of transplanted tumor growth and under total irradiation with ionizing radiation is studied. It is shown that sodium nucleinate possesses stimulating abilty both in relation to intact animals and to irradiated tumorcarriers. This stimulation is obviously conditioned by an increase of functional activity of immunocompetent cells and not by their content in spleen. Depression of function or relative content of suppressive cells both antigen-dependent and tumor-associated can be one of the mechanisms of such a stimulation. Investigation results testing tothe prospects of sodium nucleinate application under radial and combined treatment of oncologic patients. 8 refs.; 2 tabs.

53493 (INIS-SU–131/A, pp. 57-62) **Radioprotective effects of sodium nucleinate.** Surinov, B.P.; Isaeva, V.G. Akademiya Meditsinskikh Nauk SSSR, Moscow (USSR); Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii, Obninsk (USSR). 1989. (In Russian). In *Interferon inductors and other immunomodulators in radiology and oncology. Scientific reports collection.* Order Number DE90705924. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
TB-02943.

Radioprotective efficiency of sodium nucleinate in relation to immunity system under oral introducion when RNA absorption by the organism in the polymer form is practically impossible due to the presence of high-activity RNA-ase in intestine is demonstrated. It is obvious, that radioprotective effect of sodium nucleinate can be realized only by products of its decomposition including nucleotides and nucleozides. 6 refs.; 2 tabs.

53494 (INIS-SU–131/A, pp. 62-65) **Dose dependence of sodium nucleinate effect on antibody formation in case of various types of it's injection to irradiated and intact animals.** Isaeva, V.G. Akademiya Meditsinskikh Nauk SSSR, Moscow (USSR); Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii, Obninsk (USSR). 1989. (In Russian). In *Interferon inductors and other immunomodulators in radiology and oncology. Scientific reports collection.* Order Number DE90705924. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
TB-02943.

Comparative investigation into efficiency of various doses and methods of sodium nucleinate introduction for antibody formation of intact animals and after ionizing radiation effect is conducted. Sufficient differences in efficiency of such methods of injection as single intraperitoneal, single peroral in large doses or fractional peroral ones are demonstrated. Advantaes of peroral fractional injection are obvious. It is assumed that under different injecion methods mechanisms of immunostimulating effect of this preparation can be different. 5 refs.; 2 tabs.

53495 (INIS-SU–131/A, pp. 65-68) **Effect of immunomodulators on immunoreactivity recovery following combined effect of radiation and thermal injury.** Makarov, G.F.; Agapova, G.G. Akademiya Meditsinskikh Nauk SSSR, Moscow (USSR); Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii, Obninsk (USSR). 1989. (In Russian). In *Interferon inductors and other immunomodulators in radiology and oncology. Scientific reports collection.* Order Number DE90705924. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
TB-02943.

It is shown that certain immunomodulators products a sufficient effect on immunoreactivity recovery only after combined effect of radiation and thermal injury in non-lethal doses. It is notable that in this case the antiboby formation level exceeds sufficiently the similar index even in healthy animals. Early injection of thymoptine immunostimulator as well as its combination with cystamine radioprotector are inefficient for antibody formation recovery under combined radiation-thermal injury. 4 refs.

53496 (INIS-SU–131/A, pp. 68-71) **Efficiency of early application of immunomodulators in combined effect of radiation and thermal injury.** Makarov, G.F. Akademiya Meditsinskikh Nauk SSSR, Moscow (USSR); Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii, Obninsk (USSR). 1989. (In Russian). In *Interferon inductors and other immunomodulators in radiology and oncology. Scientific reports collection.* Order Number DE90705924. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.
TB-02943.

Medical effect of thymus preparations (thymoline, thymoptine) and levamysole under combined radiation-thermal injury is studied. Experimental results have shown that early application of certain immunostimulators under combined radiation-thermal injury of medium criticality is low-efficient. Their ability to sufficiently increase the antibody synthesis is manifested only under combined action of burns and irradiation in non-lethal doses. 5 refs.

53497 (IPPJ-REV–3) **Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.** Okada, S. (ed.). Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. 310p. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

Individual papers are processed separately for the data base. (DLC)

53498 (IPPJ-REV–3, pp. 24-31) **Japanese university program on tritium radiobiology and environmental tritium.** Okada, Shigefumi (Kyoto Univ. (Japan). Radiation Biology Center). Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

The university program of the tritium study in the Special Research Project of Nuclear Fusion (1980-1989) is now on its 9th year. The study's aim is to assess tritium risk on man and environment for development of Japanese Nuclear Fusion Program. The tritium study begun by establishing various tritium safe-handling devices and methods to protect scientists from tritium contamination. Then, the tritium studies were initiated in three areas: The first was the studies on biological effects of tritiated water, where their RBE values, their modifying factors and mechanisms were investigated. Also, several human monitoring systems for detection of tritium-induced damage were developed. The second was the metabolic studies of tritium, including a daily tritium monitoring system, methods to enhance excretion of tritiated water from body and means to prevent oxidation of tritium gas in the body. The third was the study of environmental tritium. Tritium levels in environmental waters of various types were estimated all-over in Japan and their seasonal or regional variation were analyzed. Last two years, the studies were extended to estimate tritium activities of plants, foods and man in Japan. (author).

53499 (IPPJ-REV–3, pp. 46-58) **High specific activity of organically bound tritium in pine needles and search for its cause in the environment.** Takashima, Yoshimasa (Tohoku Univ., Sendai (Japan). Faculty of Science); Momoshima, Noriyuki; Kaji, Toshio. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

In order to measure low level tritium in biological materials, an improved method was established. This method was applied to a number of pine needles. Tritium in pine needles is divided into two categories, i.e., tritium in tissue free water (TFWT) and organically bound tritium (OBT). The former is easily collected by freeze drying, but the latter requires combustion of dried samples. The combustion water is collected in a trap immersed in dryice-alcohol. The water thus collected is used for scintillation counting after distillation. We measured tritium concentrations in pine needles collected from 21 locations in all over Japan which are considered to be far enough removed from the influences of nuclear facilities. In addition to them, the same procedures were applied to pine needles collected in the vicinity of nuclear facilities. Tritium concentrations in pine needles of ordinary locations are higher in organic matter than in tissue free water with the ratio, ca. 1.5. The ratios are quite variable for the pine needles in the vicinity of nuclear installations suggesting that this method is useful for the environmental monitoring. The cause for high specific activity of organically bound tritium is not fully confirmed. However, we consider that this excess OBT may be attributed to direct assimilation of HT that presents in the atmosphere with extremely high specific activity. (author).

53500 (IPPJ-REV–3, pp. 64-73) **Controlled environment estimations of HT uptake by vegetation.** Murphy, C.E. Jr. (Sarannah River Lab., Aiken, SC (USA)). Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133*

on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center. Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

A controlled environment system was constructed to determine the rate of uptake of tritium from atmospheric tritiated molecular hydrogen (HT). The system provided control of air temperature, air humidity, light intensity, and the concentration of HT in the air. Exposure of representative crop species for a period of one hour indicates a very low rate of oxidation of HT by the leaves of the plants. Deposition velocities were calculated to average 2×10^{-6} cm/s. Rates of incorporation of tritium into the organic fraction of the plants was a factor of 30 less than the rate of oxidation. These results suggest that the uptake of HT by plants is not a major source of dose to man following accidental HT releases. (author).

53501 (IPPJ-REV–3, pp. 74-83) **Behavior of organically bound tritium in some plants under equilibrium and non-equilibrium environmental conditions.** Inoue, Yoshikazu (National Inst. of Radiological Sciences, Chiba (Japan)); Iwakura, Tetuo. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

To understand behavior of organically bound tritium (OBT) in the environment, concentration ratios of OBT to tissue free water tritium (TFWT) were compared between a rice plant grown under equilibrium condition and a pine tree grown under non-equilibrium condition. The OBT to TFWT ratio of rice was 0.69+-0.38 as an average for the polished rice harvested in the whole Japan in 1985. On the contrast, the ratio of pine needles collected near nuclear facilities changed with time between 1 and 2. It is concluded that the concentration ratio of OBT to TFWT in the plant keeps less than unity under the equilibrium condition, but it is possible to become larger than unity under the non-equilibrium condition, because OBT has longer retention time in the plant than TFWT. (author).

53502 (IPPJ-REV–3, pp. 84-87) **Tritium content in Japanese bodies.** Ujeno, Yowri (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.); Aoki, Toru; Yamamoto, Keiichi; Kurihara, Norio. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

Tritium contents of tissue free water (TFWT) and tissue bound water (TBT) in 94 tissues from 32 autopsied Japanese bodies were measured. TFWT was measured in water removed by a freeze drying method and TBT was measured in water obtained by a combustion method with Pt and a high quality oxygen gas. Tritium was counted with two instruments which can detect tritium against background levels. The TFWT averages were 2.6 Bq/l in the brain, 3.3 Bq/l in the lung, 3.3 Bq/l in the liver, 6.1 Bq/l in the kidneys, 2.6 Bq/l in the muscle and 3.8 Bq/l in the spleen. TBT was 16.7 Bq/l in the lung and 15.5 Bq/l in the liver of one body. It is assumed that one of the reasons for obtaining such high TBTs is contamination by unknown substances which have a similar scintillation spectrum as that of tritium. (author).

53503 (IPPJ-REV–3, pp. 88-93) **Transfer of fallout ^{3}H from diet to human in Akita, Japan.** Hisamatsu, Shun'ichi (Akita Univ. (Japan). School of Medicine); Takizawa, Yukio; Abe, Touru; Ito, Mikio; Ueno, Kaoru; Katsumata, Tei'ichi; Sakanoue, Masanobu. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

Tritium concentrations in diet at Akita City, and in human tissues from general population in Akita Prefecture were analyzed to study fallout ^{3}H transfer from diet to human body. The specific activity ratios of tissue bound ^{3}H to free water ^{3}H in the diet and human tissues were found to be close to unity in significant contrast with those reported in Italy and U.S.A. The free water ^{3}H concentrations in human tissues agreed well with the those in diet including tap water. The specific activity ratio of tissue bound ^{3}H to free water ^{3}H in human tissues was slightly lower than that in diet, and agreed with the predicted value with the four compartment model. (author).

53504 (IPPJ-REV–3, pp. 99-106) **Bioassay of hair for estimation of body burden by tritium exposure.** Takeda, Hiroshi (National Inst. of Radiological Sciences, Chiba (Japan)); Iwakura, Tetsuo. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

For accurate estimation of radiation dose to human body from tritium exposure, it is needed to assess the concentration of tritium organically bound to the tissue constituents(OBT) as well as body water tritium. Since hair is an easily accessible tissue, it seems to be interesting to study the possibility of using hair for this purpose. In the present study, the pattern of tritium incorporation into hair and the quantitative relationship between OBT content in hair and in other internal tissues were investigated in rats exposed singly or continously to tritiated water, tritiated leucine and tritiated glycine. The rate of tritium incorporation into hair was slower than that into other tissues and the maximum concentrations were found on the 15-30th day after a single ingestion. The alterations in the concentration of OBT in internal tissues due to the difference of chemical form of ingested tritium were reflected on the OBT concentration in hair. Especially, the OBT content in hair under the condition of continuous exposure was almost the same as that in other tissues. These findings indicate the validity of hair analysis as a means for assessing OBT deposition in the body or tissues. (author).

53505 (IPPJ-REV–3, pp. 59-63) **Fixation of tritium gas by a pine tree and its surroundings.** Ichimasa, Michiko (Ibaraki Univ., Mito (Japan). Faculty of Science); Ichimasa, Yusuke; Akita, Yasukazu. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

The fixation (oxidation) of atmospheric tritium gas (HT) in vegetation in in vitro experiments was determined for pine needles, pine bark, lichen attached to pine trees, taken from a coastal pine forest, and compared with that in soil. HT oxidation in pine needles was extremely low and about 1/40000 that in the surface soil, whereas its oxidation in pine bark with a lichen was almost 1000-7000 times that in pine needles. In vivo laboratory experiments on HT fixation in pine trees were conducted using one-way circuit inhalation apparatus and potted dwarf pine trees. After 2 hours of exposure to HT, tritium distribution and its specific activity in pine needles, branches, trunk, roots and soil were measured. Tritium distribution in the pine needles was 0.30% that in the soil. However, HT oxidation in the pine needles was only about 0.003% that in the soil. (author).

53506 (IPPJ-REV–3, pp. 107-111) **Comparison of oxidation activity of tritium gas among various animals and man. Analysis of intestinal bacterial flora for oxidation.** Ichimasa, Michiko (Ibaraki Univ., Mito (Japan). Faculty of Science); Ichimasa, Yusuke; Hashimoto, Noriko; Oda, Minoru; Akita, Yasukazu. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

The oxidation of tritium gas (HT) by fecal suspensions from rat, monkey and man was measured under aerobic and anaerobic

conditions. In any case tested, the HT oxidation activity in fecal suspension under anaerobic conditions was almost the same among animals and man and remarkably higher than that under aerobic conditions. In oder to understand what kinds of bacteria actually oxidize HT in the intestine, a number of bacterial strains were isolated from rat and human feces by using various media for isolation and selection of intestinal anaerobes. Among the isolates, 27 strains derived from rat feces and 63 strains from human feces were found to oxidize HT under anaerobic conditions. Most of them were identified as some species of Bacteroides, Fusobacterium, Veillonella or Clostridium, and some of them were facultative anaerobes and identified as Escherichia coli. HT oxidation activity of Veillonella was highest. All strains identified as Lactobacillus acidphilus, L. plantarm of Bifidobacterium adlescentis did not oxidize HT. (author).

53507 (IPPJ-REV–3, pp. 112-117) **Can oxidation of tritium gas in intestine be suppressed by a drug in rats?.** Ichimasa, Yusuke (Ibaraki Univ., Mito (Japan). Faculty of Science); Shiba, Hajime; Ichimasa, Michiko; Chikuuti, Masaaki; Akita, Yasukazu. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

Clindamycin is known as an antibiotic effective against intestinal anaerobes. Administration of norfloxacin or clindamycin to rats began 1, 2, 3 or 4 days before commencement of exposure to tritium gas respectively and kept up until the day before exposure to tritium gas. After exposure to tritium gas for 2 hours, rats were sacrificed and tritium activity of various tissues and blood were determined. Tritium concentration in blood decreased in proportion to the period of administration of a drug. In the case of norfloxacin, tritium concentration in rat body decreased 1/5 that in non-treated rats. On the other hand, when administration of clindamycin began the day of exposure and kept up for 4 days, the biological half life of administrated rats was shortened to 3/5 that of non-treated rats.

53508 (IPPJ-REV–3, pp. 118-122) **How far intensitive instillation will get rid of tritium from body of rats?.** Ichimasa, Yusuke (Ibaraki Univ., Mito (Japan). Faculty of Science); Abe, Miyuki; Fukusima, Yuuko; Kitamura, Masami; Chikuuti, Masaaki; Akita, Yasukazu. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

Following a single administration of tritiated water (HTO) by injection, rats daily received instillation of one of the following fluids, Ringer's solution, 10% glucose, low molecular dextran or KN2B fluid maintenance, through into a tail vein. In some experiments, a diuretic, sodium acetazolamide, was also administerd by daily intramuscular injection in combination with instillation. After 8 days treatment, rats were sacrificed and total and tissue bound tritium activities in various tissues and blood were determined. All fluids tested were found to enhance successfully the excretion of the incorporated tritium. Especially, joint administration of Ringer's solution and sodium acetazolamide facilitated the decrease of tritium activity in urine most effectively. The biological half-life in joint administrated rats was shortened to 1.2 days in contrast to 3.0 days in control rats and total tritium activity of various tissues decreased to about one tenth that of tissues in control rats. These enhancing effects of instillation treatments were observed in prolonged treatment up to 75 days. (author).

53509 (IPPJ-REV–3, pp. 123-128) **Tritium absorption through various types of trauma in the skin of hairless mice and its prevention.** Sawada, Shozo (Hiroshima Univ. (Japan). Research Inst. for Nuclear Medicine and Biology). Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

The rate of absorption of tritium through traumatized skin was assessed by studying its absorption in an animal model. Using female hairless mice(SKH/hr-1), incision, abrasion, thermal burn, and chemical burn caused by HCl were artificially inflicted on the skin of the back of the mice. One drop of tritiated water (HTO) was placed on the traumatized skin and the radio-activity was measured in small blood samples every 10 minute. Although the nature of trauma was quite different from one another, the rate of absorption was 18 times faster for incisions, 12 times faster for abrasions, 10 times faster for thermal burns and 1.2 times faster for chemical burns. Similar experiments were performed using tritium vapor because HTO evaporated easily. It was noted that except with incisions, the rate of absorption of tritium vapor was similar to that of HTO in abrasions, thermal burns and chemical burns by HCl. In the case of incisions, the rate of absorption of tritium vapor was significantly slower than that of HTO. Changes in the absorption rate of HTO and tritium vapor during recovery from abrasions were also measured. It was observed that the rate decreased and attained that of normal skin absorption values 10 to 16 days. The inhibition of tritium absorption through abrasion was also studied. Nivea cream showed the most effective inhibition. (author).

53510 (IPPJ-REV–3, pp. 143-147) **Effect of tritiated water on human hemopoietic stem cells.** Shigeta, Chiharu (Hiroshima Univ. (Japan). Research Inst. for Nuclear Medicine and Biology); Kamada, Nanao; Ohkita, Takeshi. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

Effects of tritiated water beta rays, 60 cobalt gamma rays and 252 californium neutrons on hemopoietic stem cells from human bone marrow were studied using in vitro cell culture techniques. The two kinds of progenitor cells in erythroid lineage, BFU-E and CFU-E, were more radiosensitive than those of stromal stem cells, CFU-F, to the three radiation sources. All the survival curves of the erythroid progenitor cells showed a linear shape, however, those of stromal stem cells irradiated with 60 cobalt had an initial shoulder. Therefore, by estimation based on data from CFU-F, RBEs of tritiated water and 252 californium was more than 3 under 1 Gy. (author).

53511 (IPPJ-REV–3, pp. 148-158) **Chromosomal damage in human spermatozoa caused by in vitro irradiation of tritium β-rays.** Kamiguchi, Yujiroh (Asahikawa Medical Coll., Hokkaido (Japan)); Tateno, Hiroyuki; Mikamo, Kazuya. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

Effects of tritium (HTO) β-rays on human sperm chromosomes were studied using our interspecific in vitro fertilization system between human spermatozoa and zona-free hamster oocytes. Semen samples were treated with media containing 1.53 - 24.30 mCi/ml HTO for about 80 minutes. Six hundred and forty-six spermatozoa were karyotyped in the controls and 1,383 spermatozoa in the irradiated groups. The incidence of spermatozoa with structural chromosome aberrations increased linearly with increasing dosage. Breakage type aberrations occurred far more frequently than the exchange type. Chromosome type aberrations appeared far more frequently than the chromatid type. All of these types of aberrations showed linear dose-dependent increases. The RBE values of HTO β-rays relative to X-rays were calculated for the above-mentioned 5 indices, respectively. Their RBE values ranged from 1.91 to 3.18 when the absorbed dose was estimated to be the minimum, whereas the values ranged between 1.05 and 1.75 when the absorbed dose was estimated to be the maximum. (author).

53512 (IPPJ-REV-3, pp. 159-163) **RBE of tritium beta-rays for cell killing of normal human cells in vitro.** Nakamura, Nori (Radiation Effects Research Foundation, Hiroshima (Japan)). Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190-: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

RBE of tritium beta-rays for cell killing was obtained for three types of human cells. Cells were treated either by tritiated water or by 60-Co gamma-rays for up to 2 hours at 37degC and resulting dose-survival curves were fitted by a linear quadratic equation. The ratios of the dose-linear terms gave maximum RBE of 1.4 for skin fibroblasts, 2.3 for thyroid epithelial cells and 2.8 for peripheral T lymphocytes. (author).

53513 (IPPJ-REV-3, pp. 164-169) **Single-strand breaks in DNA and transformation inactivation induced by tritiated water.** Takakura, Kaoru (International Christian Univ., Mitaka, Tokyo (Japan)). Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190-: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

The induction of single-strand breaks in DNA by tritiated water in aqueous solution was studied by agarose gel electrophoresis. Also the transformation inactivation of the DNA was studied with ampicillin resistance as a marker when the DNA transfer E.coli cells (HB101). Plasmid DNA, pBR322, in SSC buffered solution was kept with tritiated water of different concentrations ranging 5.88 x 10^{-2} Gy/h - 1.18 x 10^{-4} Gy/h at 4degC, that is, the DNA was irradiated at several different dose rates. Accumulated hydrogen peroxide in tritiated water was removed by catalase treatment just before adding tritiated water to DNA solution. After the irradiation with tritiated water DNA was rinsed by isotope-free SSC buffer to eliminate the radioactivity using ultra filtration filter, than the DNA was used to analyse its single-strand breaks and transformation inactivation. As the result it was observed that the efficiencies of single-strand breaks and transformation inactivation increased as decreasing dose rate. The values of relative biological effectiveness (RBE) were obtained to be about 0.3 - 0.4 for single-strand breaks and about 1 for transformation inactivation using the result from the irradiation with Co-60 gamma-rays at the similar low dose rate. (author).

53514 (IPPJ-REV-3, pp. 170-172) **Intracellular damage of DNA induced by tritiated water and its restoration.** Sakai, Kazuo (Tokyo Univ. (Japan). Faculty of Medicine); Nakamura, Nori; Suzuki, Norio; Okada, Shigefumi. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190-: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

Induction and repair of DNA breaks were studied in mouse L5178Y cells after exposure to tritiated water (HTO) or X-rays. The amount of DNA breaks immediately after HTO-treatment was linearly increased to the dose and was smaller than the initial breaks by X-rays; RBE was 0.6. Repair profiles of DNA breaks revealed that HTO-induced breaks contained a larger proportion of slow/non-reparable components. The dose response curves of non-reparable breaks, which were determined 10hr after HTO-treatment of X-irradiation, were curvilinear and overlapped each other. These results indicate that RBEs of HTO previously reported for cell killing (1.0) and mutagenesis (1.2-1.3) were correlated with the amount of remaining breaks but not by the initial breaks. (author).

53515 (IPPJ-REV-3, pp. 173-179) **RBE of tritium beta radiation to gamma radiation and X-rays analyzed by both molecular and genetic methods.** Lee, W.R. (Louisiana State Univ., Baton Rouge (USA). Dept. of Zoology and Physiology). Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190-: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

The relative biological effectiveness (RBE) of tritium beta radiation to ^{60}Co gamma radiation was determined using sex-linked recessive lethals (SLRL) induced in Drosophila melanogaster spermatozoa as the biological effect. The SLRS test, a measure of mutations induced in germ cells and transmitted through successive generations, yields a linear dose-response curve in the range used in these experiments. From these ratios of the slopes of the ^{3}H beta and the ^{60}Co gamma radiation linear dose response curves, an RBE of 2.7 is observed. When sources of error are considered, this observation suggests that the tritium beta particle is 2.7 +- 0.3 times more effective per unit of energy absorbed in inducing gene mutations transmitted to successive generation than ^{60}Co gamma radiation. Ion tracks with a high density of ions (high LET) are more efficient than tracks with a low ion density (low LET) in inducing transmissible mutations, suggesting interaction among products of ionization. Molecular analysis of X-ray induced mutations shows that most mutations are deletions ranging from a few base pairs as determined from sequence data to multi locus deletions as determined from complementation tests and Southern blots. (author).

53516 (IPPJ-REV-3, pp. 180-188) **Adaptive response of human lymphocytes to very low doses of radiation from tritiated thymidine or X rays. A case of induced repair.** Wolff, S. (California Univ., San Francisco (USA). Lab. of Radiobiology and Environmental Health). Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190-: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

When human lymphocytes are cultured with [^{3}H] thymidine under conditions whereby only one disintegration of tritium occurs, or are exposed to very low doses of X rays (0.5 - 1.0 cGy) of 250 kVp X rays, the cells become adapted to radiation in that they become refractory to subsequent exposures to high doses of X rays or exposures to many chemical agents. That is, cells pre-exposed to low doses of [^{3}H] thymidine or of X rays that in themselves do not induce a sensible number of chromatid breaks have up to one-half as many breaks induced by higher doses. This response can also be induced by agents that produce double-strand breaks in DNA, such as H_2O_2 or the radiomimetic agent, bleomycin, and can be inhibited by 3-aminobenzamide (3-AB), an inhibitor of poly (ADP-ribose) polymerase induced in response to the production of strand breaks in DNA, and also inhibited by the protein synthesis inhibitor, cyclohexamide. These data are interpreted as indicating that the adaptation is caused by the induction of a hitherto unknown repair mechanism that if in place at the time of the exposure to high doses, will result in less of the initial damage being converted to frank chromosomal breaks, i.e., will result in less cytogenetic damage. Two-dimensional gel electrophoresis experiments carried out on the proteins found in lymphocytes exposed to 1 cGy of X rays have shown that these low doses indeed do reproducibly induce specific proteins that are not present in unirradiated lymphocytes. These new proteins are considered to be good candidates for being the induced repair enzymes. (author).

53517 (IPPJ-REV-3, pp. 189-199) **Novel chromosomal response to low-level tritium. Adaptive response induced by ionizing radiation in cultured Chinese hamster cells.** Ikushima, Takaji (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190-: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

Pre-treatment with low doses of β-rays from incorporated tritiated thymidine (^{3}H-dThd) or of Co-60 γ-rays (1 or 5 cGy) rendered actively growing Chinese hamster V79 cells more resistant to the induction of micronuclei or sister chromatid exchanges (SCEs) by a subsequent high dose of γ-rays (1 Gy). This adaptive response to ionizing radiation can be induced by an optimal range of low doses of ^{3}H β-rays, but not by much lower or higher adapting doses. The induced resistance was abolished after the ^{3}H-adapted cells had divided once or when 3-aminobenzamide (3AB) was given before the challenging doses, which suggests a short life for the adaptive response and the involvement of poly (ADP-ribose) polymerase in this response. The ^{3}H-adapted cells were somewhat resistant to SCE-induction but not to micronucleus-induction by challenge doses of high LET radiation from the reactor, KUR. Full expression of the adaptive response induced by the exposure to low doses of ^{60}Co γ-rays occurred 4 h after the adapting dose. The cells pre-exposed to low doses of γ-rays showed cross-resistance to challenge doses of γ-rays, itself and also of mitomycin C (MMC) and near ultraviolet light (UV-B, 313 nm), but not to those of ethyl methanesulfonate (EMS) or cisplatinum (II) diammine dichloride (cisplatin) for SCE induction. These results suggest that the adaptive response to ionizing radiation is different from that to alkylating agents, and that it may be mediated through a hitherto unknown inducible DNA-repair network. (author).

53518 (IPPJ-REV–3, pp. 137-142) **Development of a monitoring system for human exposure to tritium. Chromosome aberrations in human lymphocytes exposed to HTO.** Morimoto, Kanehisa (Osaka Univ. (Japan). Faculty of Medicine); Ogawa, Yasutaka; Okayama, Akira; Shirakawa, Taro; Miura, Kunihiko. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

Human lymphocytes at G_0 were exposed in vitro to HTO to obtain the dose-response relationship between exposure and the dicentric and ring (D+R) frequency, to see the dose-rate effect on the chromosome aberration frequency, to calculate mean value of relative biological effectiveness (RBE) at the dose-range examined, to investigate the enhancing effect of the combined treatment with metabolic inhibitors on the HTO-induced chromosome aberrations, and to evaluate the influences of the life-styles of the blood donors on the enhancement of HTO-induced chromosome aberration frequencies by a metabolic inhibitor cytosine arabinoside (ara-C). The dose-response curve obtained was shown to be fitted by a power model: Y = 0.205 $X^{1.29}$, or a linear quadratic model: Y = 1.5center dot10^{-3} X + 1.9center dot10^{-6} X^2, where X is HTO exposure in cGy and Y is the D+R frequency. When lymphocytes were exposed to HTO at 3 different dose rates, it was found that exposure at 0.042 Gy/h produced a 30% smaller number of D+R chromosomes than exposure at 0.5 Gy/h. Mean RBE value was estimated to be 1.49 +- 0.21 within the dose range examined. In cultures exposed to 2-Gy HTO β-rays along with various metabolic inhibitors, a remarkably enhanced ratio of D+R frequencies was observed when cells were combinedly exposed to ara-C, varying from 2 to 5 among lymphocytes from different blood donors. Caffeine, fluorodeoxyuridine (FUdR) or 3-aminobenzamide (3-AB) also enhanced HTO-induced chromosome aberrations by 20-50% whereas hydroxyurea (HU) and cycloheximide (CHX) appear not to affect the HTO-induced D+R frequency. With blood donors who excessively smoked cigarettes, consumed alcohol beverages, or were mentally stressed, etc., there appeared to be a significant influence on the ara-C enhancement effect.

53519 (IPPJ-REV–3, pp. 200-210) **Cell killing and mutation to 6-thioguanine resistance after exposure to tritiated amino acids and tritiated thymidine in cultured mammalian cells.** Ueno, A.M. (National Inst. of Radiological Sciences, Chiba (Japan)); Furuno-Fukushi, Ikuko; Matsudaira, Hiromichi. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

Cell killing and mutation to 6-thioguanine resistance were studied in growing mouse leukemia cells (L5178Y) in culture after exposure to tritiated amino acids and tritiated thymidine, and compared to those following HTO and γ ray exposure. These effects varied widely among the tritiated compounds tested, being greatest for tritiated thymidine followed by tritiated arginine and tritiated lysine, tritiated leucine, in that order, for a given concentration of tritium expressed in kBq/ml of tritium in the medium. A difference of 3 order of magnitude was found between tritiated thymidine and HTO. The differences between each tritiated amino acid and those between tritiated amino acids and HTO disappeared almost totally when the effects were compared on the basis of the absorbed dose to the cell. The effects of tritiated thymidine, however, remained more than two-fold greater compared to other tritiated compounds including HTO. The results indicate the importance of determining the absorbed dose for assesment of the radiotoxicity of tritiated compounds. For an exceptional case (tritiated thymidine), contribution of a mechanisms(s) other than β irradiation should also be taken into account. Similar studies are being carried out in contact inhibited near-diploid mouse embryonic skin cells (m5S), kindly provided by Dr. M. S. Sasaki. For cell killing, results essentially similar to those found in the L5178Y cells were obtained for tritiated compounds tested: tritiated leucine, tritiated arginine and tritiated lysine. (author).

53520 (IPPJ-REV–3, pp. 211-216) **Neoplastic transformation and chromosome aberration induced by tritiated water in golden hamster embryo cells.** Suzuki, Fumio (Kanazawa Univ. (Japan). Faculty of Pharmaceutical Sciences); Mori, Toshio; Nikaido, Osamu; Suzuki, Keiji; Watanabe, Masami. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

Using cultured golden hamster embryo (GHE) cells, we examined the induction of cell killing, neoplastic transformation and chromosome aberration by exposure to tritiated water (HTO) and compared its biological effectiveness with those of X- or ^{60}Co γ-rays and fission neutrons from ^{252}Cf. X- and γ-rays showed similar dose-response curves for cell survival and transformation. The cells irradiated with these radiations in ice-cold condition were much more sensitive for the induction of cell killing and transformation than those exposed at 37degC. A similar temperature dependency was observed with HTO treatment, although the effect of HTO was higher for cell killing but lower for transformation than those of X- and γ-rays. On the other hand, fission neutrons were much more effective for the induction of both the cell killing and transformation in either warm or cold condition. The cells treated with HTO produced more chromosome aberrations that those exposed to X-rays. In the cells survived after exposure, however, X-irradiated cells showed higher frequency of trisomy and monosomy than HTO treated cells. From these data, we conclude that the biological reaction of β-rays from HTO is not similar to those of X- or γ-rays and neutrons. (author).

53521 (IPPJ-REV–3, pp. 217-222) **Cell death induced in mouse intestine by tritiated water, tritiated thymidine and gamma rays.** Ijiri, Ken-ichi (Tokyo Univ. (Japan). Radioisotope Center). Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

Cell death induced by continuous irradiation with gamma rays (externally given by a Cs-137 source) or with beta rays from tritiated water (HTO) injected ip was quantified in the crypts of two portions of mouse bowel, i.e., small intestine (SI) and descending colon (DC). The time-course changes in the incidence of cell death after

each type of radiation were studied. For 6-h continuous gamma irradiation with various dose-rates (0.6 - 480 mGy/h) and for 6 h after HTO injection of various radioactivities (0.15 - 150 GBq per kg body weight), relationships between dose-rate and incidence of cell death were obtained and survival curves were constructed. For the calculation of the absorbed dose from HTO, water content of the cells was assumed to be 70 %. The mean lethal dose-rate i.e., the dose-rate which reduced survival to 37 % was calculated for gamma rays and HTO, and RBE of HTO was obtained. The RBE of HTO relative to gamma rays for cell killing in both SI and DC of mouse intestine lies around 1.4-1.6. Tritiated thymidine (^{3}HTdR) was also injected to mice, and its effects on cell killing were studied. (author).

53522 (IPPJ-REV–3, pp. 223-228) **Carcinogenic effect of tritiated water (HTO) in mice in comparison with those of fission neutrons and gamma-rays.** Yokoro, Kenjiro (Hiroshima Univ. (Japan). Research Inst. for Nuclear Medicine and Biology); Yamamoto, Osamu; Seyama, Toshio; Nitta, Yumiko; Niwa, Ohtsura. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

Carcinogenic effect of radiations with different quality was assessed in female (C57BL/6N x C3H/He)F_1 mice given either 2.7 Gy of fission neutrons from a ^{252}Cf source or ^{60}Co gamma-rays, or a single i.p. injection (2.8×10^8, equivalent to 2.7 Gy) of HTO. A prominent carcinogenic effect of fission neutrons was shown; tumors were developed with a shorter latency, higher frequency, wider spectrum of the target tissue and higher tumor multiplicity in individual animals as compared with those of HTO beta-rays or ^{60}Co gamma-rays. The RBE in carcinogenicity of HTO doesn't exceed much gamma-rays in the dose range employed in the present study. (author).

53523 (IPPJ-REV–3, pp. 230-233) **In vivo somatic mutation in mice induced by tritiated water.** Nomua, Taisei (Osaka Univ. (Japan). Faculty of Medicine); Yamamoto, Osamu. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

To estimate genetic risk of tritiated water to humans, we examined dose-response relationship of mutation in the whole body with the use of very sensitive in vivo method to detect somatic mutation in mice. PT females (a/a, b/b, pc^{ch}, pc^{ch} d/d) were mated with HT males (a/a, pa/pa, In/In, pe/pe), and then F_1 embryos from PT x HT cross, heterozygous at 7 recessive coat color genes, were treated with a single i.p. injection of 4.4, 2.2, and 0.7 MBq of tritiated water per g of body weight at 14:00 on the 10th of gestation. Somatic mutation was detected as a colored spot on the non-agouti (black) background 4 weeks after birth. Frequency of vivo somatic mutations induced by tritiated water increased almost linearly with doses of tritiated water; 22/750 (0.03), 13/133 (0.10), 12/92 (0.13), and 22/85 (0.26) at 0, 0.7, 2.2, and 4.4 MBq/g, respectively. Cummulative doses of tritium for 4 days from the 10th to 14th day of gestation, were approximately 70 % of the total (30 rad as absorbed dose). Mutation rate per locus per μCi/g was calculated to be 1.8×10^{-7}. On the assumption that dose-response curve by the reference radiation (chronic X-ray exposure) is linear at 30 rad, RBE of tritiated water was estimated to be about 2.7 at present. These values are similar to those for spermatogonial mutation. (author).

53524 (IPPJ-REV–3, pp. 234-238) **Dose-rate dependency of radiation-induced germ cell mutation. Development of a new mutation assay system using the fish, Medaka Oryzias latipes.** Shimada, Atsuko (Tokyo Univ. (Japan). Faculty of Science); Shima, Akihiro. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

A new specific-locus mutation assay system using the fish Oryzias latipes has been developed. An advantage of our system is that we can detect deaths around hatching period of many mutant embryos whose mutant phenotypes could be recognized, as 'total mutations', early after fertilization. This system has revealed that 80 to 90 % of the embryos with total mutations induced in spermatogonia by gamma-rays died of some developmental defects before hatching. We are studying dose-rate dependency of total mutations as well as viable mutations induced in spermatogonia. Although our data are still incomplete, it is indicated that no dose-rate effect was found in total mutations, whereas dose-rate effect exists with regard to viable mutations under the present experimental conditions. (author).

53525 (IPPJ-REV–3, pp. 251-263) **Effect of tritiated water on germ cells and fertility. A comparative study with tritium simulation using oocyte death of mouse newborns as index.** Satow, Yukio (Hiroshima Univ. (Japan). Research Inst. for Nuclear Medicine and Biology); Hori, Hiroshi; Ohtaki, Megu; Nakamura, Nori. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

The relative biological effectiveness (RBE) of tritiated water (HTO) was sought by comparison with the results of tritium simulation using Cs-137 and the results obtained by irradiating with Co-60 gamma rays and fission neutrons (Cf-252) for reference, using as index the lethal effect on mouse newborn oocytes. The method was to inject various doses of HTO once into the abdominal cavity of ICR mouse on the 14th day after birth and the survival rate of oocytes were calculated. As a result, the number of surviving oocytes decreased exponentially depending on the dose of HTO or Cs-137, and 1.1-3.5 was given as the RBE. Further, the resutls of the tests with Co-60 and Cf-252 that were made for reference showed the lethal effect on oocytes to be stronger in the order of Cf-252, HTO, Co-60 and Cs-137. The effects of HTO and Cs-137 on the reproductive capacity (RC) were also studied raising the female mice which were exposed to HTO or Cs-137 as same procedure. The mice were delivered of litters four times in two years. The HTO or Cs-137 induced diminution of RC may be dose dependent and seems to be non-stochastic. (author).

53526 (IPPJ-REV–3, pp. 264-273) **Radiolethal and genetic vulnerabilities of germ cells in the female mammal. Effects of tritium and other radiations compared.** Straume, T. (Lawrence Livermore National Lab., CA (USA)); Kwan, T.C.; Dobson, R.L.; Goldstein, L.S. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

We have shown that the lethality target in mouse immature oocytes is non-nuclear; it is equal in cross-sectional area to the entire oocyte and is separated from the nucleus by about 4μ. A substantial body of data now points to the plasma membrace as the lethality target in these particular cells. These new insights have led to novel experimental designs using low-energy neutrons (certain other radiations should also be usable) to identify and measure radiation-induced genetic effects in immature oocytes of the mouse. These important effects have escaped detection heretofore. We have quantified both chromosome aberrations and dominant lethal mutations in oocytes from females exposed 8 to 12 weeks earlier. Results from these and other studies show that: (1) for immature oocyte killing in mice, chronically administered ^{3}HOH is of near maximum biological effectiveness, similar to the most effective neutrons and heavy ions (likely true also for female germ-cell killing in some prenatal primates), (2) tritium incorporated into DNA as ^{3}H-Tdr is about 100 times less effective in mouse immature oocyte

killing than is tritium administered as ^3HOH, and (3) for mutagenicity in the mouse, immature oocytes appear to have approximately the same sensitivity as mature oocytes (contrary to previous claims) and show dose and LET responses similar to those obtained from genetic studies of other cells. The possible implications of these findings for women exposed to tritium are considered. (author).

53527 (IPPJ-REV–3, pp. 274-279) **Effect of organically bound tritium (OBT) on pre-implantation mouse embryos in vitro.** Yamada, Takeshi (National Inst. of Radiological Sciences, Chiba (Japan)); Ohyama, Harumi. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

Effect of organically bound tritium (OBT), such as tritiated thymidine and tritium-labeled amino acids, on mouse preimplantation embryos was examined in vitro. Mouse zygotes fertilized in vitro ($BC3F_1$ eggs x ICR sperm) were cultured in the media containing OBT in various concentrations up to the blastocyst stage. The LD_{50} in terms of tritium concentrations in the culture medium were determined by measuring tritium concentrations in the medium to inhibit 50 % of embryos to form blastocyst in vitro. Tritium activities in the embryos were measured at various times during culture of embryos at LD_{50} concentration in order to estimate absorbed radiation dose in embryonic cells. The LD_{50} values obtained indicate that OBT could inhibit the embryonic development 1000 times more effectively that tritiated water (HTO). However, differences in LD_{50} values in terms of absorbed radiation dose between OBT and HTO is not so essential, and might be explained by localized spatial distribution of OBT within the cell. (author).

53528 (IPPJ-REV–3, pp. 280-286) **Teratogenic effect of tritium water and tritium simulator on rat embryos.** Satow, Yukio (Hiroshima Univ. (Japan). Research Inst. for Nuclear Medicine and Biology); Lee, Juing-Yi; Sawada, Shozo. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

The teratogenic effects of tritium water (HTO) on rat embryos were examined and the results obtained were compared with those of tritium simulator (Cs-137 gamma-rays) for determining the relative biological effects (RBE) for the incidence of malformations. Six groups of pregnant rats were injected interaperitoneally with HTO containing 25, 50, 75, 100, 125 or 150 mCi HTO/300g B.W. on day 7, 8, 9, 10 or 11 of pregnancy. To obtain accurate RBE values of HTO in rats, five groups of pregnant rats were exposed to Cs-137 gamma-rays by tritium simulator on days 9-18 of pregnancy at exponentially decreasing doses in accordance with body tritium concentration. The rats were sacrificed on day 18 and the offsprings were examined for external and internal malformations. Malformations were seen at the highest incidence of 100 % of the survived embryos and 81.3 % of total implants in the group given 100 mCi (accumulated doses were about 451 rad) of HTO on day 9 of pregnancy. Tritium simulator accumulated doses of Cs-137 gamma-rays irradiation at 680 rad induced 98.4 % malformation in survived embryos and 71.7 % of the total implatns on day 9 of pregnancy. Both radiations (HTO and Cs-137 gamma-rays) induced similar anomalies of the cardiovascular system in rat embryos. In the present study, comparisons between HTO and tritium simulator showed the teratogenic effectof RBE to be greater than 1.8 and to reach approximately 2.6. The results showed that HTO had stronger teratogenic effects as compared with those of Cs-137 gamma-rays. (author).

53529 (IPPJ-REV–3, pp. 287-292) **Tritium metabolism in animals and estimation of the accumulated dose.** Saito, Masahiro (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.); Ishida, M.R. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

This paper describes the recent advances in our laboratory in the development of the metabolic model of tritium retention for the animal body and the estimation of the dose modification factor for the organically bound tritium (OBT). Tritium retention data have been accumulated for the mice used as a model animal. These data stimulated us to propose a modified three compartment model in which the organically bound tritium (OBT) is directly taken in by a OBT compartment. This model predicts the specific activity ratio in tissue (SAR) as a function of the ratio of OBT intake compared to the intake of the free water tritium (FWT) in the daily diet at equilibrated condition. In a parallel work, the dose modification factor (DMF) for the OBT was estimated for the DNA bound tritium and the protein-bound tritium. The DMF for the DNA-bound tritium and that for the protein-bound tritium were between 2 and 6 and between 0.8 and 1.5, respectively varying among various organs. (author).

53530 (KURRI-TR–316, pp. 37-42) **Tritium concentrations in tree ring cellulose.** Kaji, Toshio (Kyushu Univ., Fukuoka (Japan). Radioisotope Center); Momoshima, Noriyuki; Takashima, Yoshimasa. Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Mar 1989. (In Japanese). (CONF-8811269–: Intensive seminar on 'tree rings', Kumatori (Japan), 29-30 Nov 1988). In *Papers presented at the intensive seminar on 'tree rings'.* Order Number DE90705931. Available from NTIS (US Sales Only), PC A05/MF A01.

Measurements of tritium (tissue bound tritium; TBT) concentration in tree rings are presented and discussed. Such measurement is expected to provide a useful means of estimating the tritium level in the environment in the past. The concentration of tritium bound in the tissue (TBT) in a tree ring considered to reflect the environmental tritium level in the area at the time of the formation of the ring, while the concentration of tritium in the free water in the tissue represents the current environmental tritium level. First, tritium concentration in tree ring cellulose sampled from a cedar tree grown in a typical environment in Fukuoka Prefecture is compared with the tritium concentration in precipitation in Tokyo. Results show that the year-to-year variations in the tritium concentration in the tree rings agree well with those in precipitation. The maximum concentration, which occurred in 1963, is attibuted to atmospheric nuclear testing which was performed frequently during the 1961 - 1963 period. Measurement is also made of the tritium concentration in tree ring cellulose sampled from a pine tree grown near the Isotope Center of Kyushu University (Fukuoka). Results indicate that the background level is higher probably due to the release of tritium from the facilities around the pine tree. Thus, measurement of tritium in tree ring cellulose clearly shows the year-to-year variation in the tritium concentration in the atmosphere. (N.K.).

53531 (NIRS-R–16) **Final report on the project research 'stochastic effects of irradiation and risk estimation'. April 1983 - March 1988.** National Inst. of Radiological Sciences, Chiba (Japan). Mar 1989. 167p. (In Japanese). Order Number DE90710149. Available from NTIS (US Sales Only), PC A08/MF A01.

The title project research was carried out through 1983-1987, by three groups for the studies of radiation carcinogenesis, human genetic effects, and radiotoxicology. 8 reports by the first group, 3 by the second, and 6 by the third group are collected in this issue. The contents are as follows. Serial sacrifice study on tumorigenesis in male C57BL/6J mice exposed to gamma-ray or fast neutron radiation; Influence of biological variables on radiation carcinogenesis; Studies on radiation-induced thymic lymphomagenesis; Modifying factors of radiation induced myeloid leukemia of C3H/He mouse; Cell kinetic studies on radiation induced leukemogenesis; Cytogenetical studies on the mechanism of radiation induced neoplasmas; Molecular biological study on genetic stability of the genome; Protein factors regulating proliferation and differentiation of normal and neoplastic cells; Studies on dose-radiation relationships for induction of chromosome abberations in stem-spermatogonia of three crab-eating monkey after low and high dose rate γ-irradiation; Risk estimation of radiation mutagenesis in man by using cultured mammalian cells; Effects of ionizing radiation on male germ cells of

crabeating monkey; Movement and metabolism of radioactive particles in the respiratory tract; Studies on dosimetry for internally deposited alpha-emitters; Comparative toxicological studies on the effects of internal exposures; Studies on treatment of alpha-radioactive wastes; Methodological studies on the inhalation of radioactive aerosols; Removal of transuranic elements by DTPA. (A. Y.).

53532 (ORNL/FTR–2459) **[Radiation protection]: Foreign trip report, November 8, 1986–November 21, 1986.** Fry, R.J.M. Oak Ridge National Lab., TN (USA). 5 Dec 1986. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89017306. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

I undertook this trip to attend the International Committee on Radiation Protection (ICRP) Committee 1 meeting held in Jerusalem. The items on the agenda were a number of reports on the following: (1) radiation effects on the developing brain, (2) RBEs for nonstochastic effects, (3) hereditary effects, (4) RBE for Auger electrons, (5) hormesis, (6) risk coefficient for radiation-induction of bladder cancer, (7) probability of causation of cancer, (8) biological basis for dose limitation to the skin, and (9) responses to questions relating to ICRP 26. On November 20, I visited Dr. S. B. Field at the MRC Cyclotron Unit at Hammersmith to discuss their new directions in research and to discuss journal editorships.

53533 (ORNL/FTR–2637) **[Induction and repair of uv damage]: Foreign trip report, July 18, 1987–July 27, 1987.** Regan, J.D. Oak Ridge National Lab., TN (USA). 7 Aug 1987. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89017348. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler attended the 8th International Congress on Radiation Research and presented a paper entitled "Xeroderma pigmentosum variant cells do not remove a uv-induced photosensitive lesion from their DNA." Approximately 1400 scientists participated in the Congress. There were five days of presentations with usually six simultaneous sessions taking place. The traveler was particularly impressed with the numerous presentations on irradiation of small molecules. There were many papers on different aspects of DNA repair. The presentations and the traveler's discussions with scientists at the Congress will be beneficial to the traveler's research program at ORNL.

53534 (ORNL/FTR–2840) **[Radiation susceptibility]: Foreign trip report, March 15–23, 1988.** Preston, R.J. Oak Ridge National Lab., TN (USA). 7 Apr 1988. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89017302. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler was a participant in a workshop at RERF that was established to determine if current data or future studies could be utilized to address the question of whether radiation-sensitive individuals could have been over-represented in the A-bomb non-survivors in Hiroshima and Nagasaki and thereby affect the cancer incidences. The topic was addressed by presentations by RERF staff on their current studies pertinent to radiation susceptibility; round-table discussions among panel members and observers; a written series of recommendations prepared by the workshop members and presented to the RERF council.

53535 (ORNL/FTR–3383) **[Radiochemical limnology]: Foreign trip report, August 12–September 16, 1989.** Olsen, C.R. Oak Ridge National Lab., TN (USA). 27 Sep 1989. 19p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90001253. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The 24th Congress of the International Association of Theoretical and Applied Limnology (SIL) was organized to provide an opportunity for about 2000 scientists representing more than 50 countries to present and discuss their research results on theoretical and applied limnology. The traveler was a co-organizer and co-chair of a special workshop/symposium at this meeting entitled "Radiochemical Limnology."

53536 (PNL–6889-HEDR) **Feasibility of using ^{129}I concentrations in human tissue to estimate radiation dose from ^{131}I: Hanford Environmental Dose Reconstruction Project.** McCormack, W.D. Pacific Northwest Lab., Richland, WA (USA). Oct 1989. 16p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-76RL01830. Order Number DE90000919. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

To use data on ^{129}I in human tissue to estimate an individual's past exposure to that radionuclide, it is necessary to know when and how the exposure occurred, and to know about any other prior and/or ongoing exposures. Moreover, to use ^{129}I data to estimate past exposure to ^{131}I, it is also necessary to know the relationship of the two radionuclides at the time of exposure. The relative quantities of ^{131}I and ^{129}I in gaseous effluents from Hanford Site facilities varied significantly because of the large variations in elapsed time between discharge of irradiated fuel from Hanford production reactors and initiation of chemical processing. The relationship of the two radionuclides also varied in the environment because the shorter-lived ^{131}I decayed and the longer-lived ^{129}I accumulated. Because of its extremely long half-life, ^{129}I from both Hanford and non-Hanford sources (such as fallout from weapons testing) has accumulated in the environment. Without an associated exposure to ^{131}I, chronic exposure to ^{129}I deposited in the environment has contributed and continues to contribute to thyroid burdens. Based on investigations conducted to date, measured levels of ^{129}I in human tissue will not provide a viable alternative for reconstruction of historical exposure to ^{131}I. 5 refs.

53537 (PNL–7135) **Offsite radiation doses from Hanford Operations for the years 1983 through 1987: A comparison of results calculated by two methods.** Soldat, J.K. Pacific Northwest Lab., Richland, WA (USA). Oct 1989. 26p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC06-76RL01830. Order Number DE90000983. Available from NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.

This report compares the results of the calculation of potential radiation doses to the public by two different environmental dosimetric systems for the years 1983 through 1987. Both systems project the environmental movement of radionuclides released with effluents from Hanford operations; their concentrations in air, water, and foods; the intake of radionuclides by ingestion and inhalation; and, finally, the potential radiation doses from radionuclides deposited in the body and from external sources. The first system, in use for the past decade at Hanford, calculates radiation doses in terms of 50-year cumulative dose equivalents to body organs and to the whole body, based on the methodology defined in ICRP Publication 2. This system uses a suite of three computer codes: PABLM, DACRIN, and KRONIC. In the new system, 50-year committed doses are calculated in accordance with the recommendations of the ICRP Publications 26 and 30, which were adopted by the US Department of Energy (DOE) in 1985. This new system calculates dose equivalent (DE) to individual organs and effective dose equivalent (EDE). The EDE is a risk-weighted DE that is designed to be an indicator of the potential health effects arising from the radiation dose. 16 refs., 1 fig., 38 tabs.

53538 (RERF-TR–1-89) **Whole-blood phagocytic and bactericidal activities of atomic bomb survivors, Hiroshima and Nagasaki.** Sasagawa, Sumiko; Yoshimoto, Yasuhiko; Toyota, Emiko; Neriishi, Shotaro; Yamakido, Michio; Matsuo, Miyo; Hosoda, Yutaka; Finch, S.C. Radiation Effects Research Foundation, Hiroshima (Japan). Apr 1989. 13p. Order Number DE90710065. Available from NTIS (US Sales Only), PC A03/MF A01.

This in vitro study evaluated the phagocytic and bactericidal activities of leukocytes in aliquots of whole blood from Hiroshima and Nagasaki atomic bomb survivors for Staphylococcus aureus. The data were analyzed by multiple linear regression. Any significant effects of exposure to A-bomb radiation could not be detected for both phagocytic and bactericidal activities of whole blood from A-bomb survivors. In addition, there were no significant effects of age categories, sex or city, except in neutrophil counts. (J.P.N.).

53539 (RERF-TR–7-88) **Comparison of the dose-response relationships for chromosome aberration frequencies between the T65D and DS86 dosimetries.** Preston, D.L.; McConney, M.E.; Awa, A.A.; Ohtaki, Kazuo; Itoh, Masahiro; Honda, Takeo. Radiation

Effects Research Foundation, Hiroshima (Japan). May 1989. 32p. (In Japanese, English). Order Number DE90710064. Available from NTIS (US Sales Only), PC A03/MF A01.

Cytogenetic data, derived from cultured lymphocytes of atomic bomb survivors and controls in the ABCC-RERF Adult Health Study cohort, have been analyzed to determine differences in the dose-response relationships for chromosome aberrations between the T65D and DS86 dose estimates and to assess differences between Hiroshima and Nagasaki. For a linear dose-response model, the average percentage of cells with at least one chromosome aberration increases less rapidly with dose in Nagasaki than in Hiroshima. The magnitude of the intercity difference in the percentage of cells with aberrations per gray is less for DS86 than for T65D, though the difference is statistically significant for both kerma and bone marrow dose with either dosimetry. The percentage of cells with aberrations per gray for DS86 kerma estimates is about 60 % greater than the corresponding T65D slope. Analyses to test nonlinearity in the dose-response function indicate significant departures ($p<.001$) from linearity, using both dosimetries for both kerma and marrow dose. Therefore, comparative results are presented for a range of RBE relationships under various linear (L) and linearquadratic linear (LQ-L) models. As an illustrative result, if one assumes an LQ-L model similar to models reported in the cytogenetic literature, with a limiting RBE of 20 at zero dose, the DS86 slope (the percentage of cells with aberrations per sievert) is 120 % greater than the corresponding T65D value. (J.P.N.).

53540 (WHC-SA-0527) **Contamination control: A balance between containment design and good practice in operation.** Sudmann, R.H. Westinghouse Hanford Co., Richland, WA (USA). Jun 1989. 12p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC06-87RL10930. (CONF-8909180–1: ANL conference on the prevention of significant safety-related events in the operation of US Department of Energy nuclear facilities, Richland, WA (USA), 11-14 Sep 1989). Order Number DE89016054. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

When working with plutonium, contamination control doesn't just happen. It must be designed into the facility and supported by operations with trained personnel and usable procedures. The concept of "total containment" tends to transfer the risk of contamination from the operator to the maintenance personnel. The risk of a contamination spread must be studied and contingencies planned for over the entire lifetime of the facility, including the decommissioning, which might be a decade or more in the future. Experience has shown that designs based solely on current operations may result in monumental problems during decommissioning. Good contamination control depends greatly on "the human factor" and therefore good operational management seems to be a larger factor for safety than the "total containment" of a glove box. Hanford operational experience indicates that gram quantities of plutonium may be safely handled in laboratory hoods when trained workers, good procedures, and workplace monitoring are in place. Experience indicates that personnel contamination events in gloveboxes mainly occur during cleanup or maintenance phases of the operation and not during routine production operations. Incidents involving glovebox operations have highlighted lessons learned. 8 refs.

53541 **Dose-response modeling of life shortening in a retrospective analysis of the combined data from the JANUS program at Argonne National Laboratory.** Carnes, B.A. (Argonne National Lab., IL (USA)); Grahn, D.; Thomson, J.F. *Radiation Research (USA)*, 119(1): 39-56 (Jul 1989).

Life shortening was investigated in both sexes of the B6CF1 (C57BL/6 x BALB/c) mouse exposed to fission neutrons and ^{60}Co gamma rays. Three basic exposure patterns for both neutrons and gamma rays were compared: single exposures, 24 equal once-weekly exposures, and 60 equal once-weekly exposures. Ten different dose-response models were fitted to the data for animals exposed to neutrons. The response variable used for all dose-response modeling was mean after-survival. A simple linear model adequately described the response to neutrons for females and males at doses less than or equal to 80 cGy. At higher neutron dose levels a linear-quadratic equation was required to describe the life-shortening response. An effect of exposure pattern was observed prior to the detection of curvature in the dose response for neutrons and emerged as a potentially significant factor at neutron doses in the range of 40-60 cGy. Augmentation of neutron injury with dose protraction was observed in both sexes and began at doses as low as 60 cGy. The life-shortening response for all animals exposed to gamma rays (22-1918 cGy) was linear and inversely dependent upon the protraction period (1 day, 24 weeks, 60 weeks). Depending on the exposure pattern used for the gamma-ray baseline, relative biological effectiveness (RBE) values ranged from 6 to 43. Augmentation, because it occurred only at higher levels of neutron exposure, had no influence on the estimation of RBEm.

53542 **Comparative metabolic behavior and interrelationships of Tc and S in soybean plants.** Cataldo, D.A. (Pacific Northwest Lab., Richland, WA (USA)); Garland, T.R.; Wildung, R.E.; Fellows, R.J. *Health Physics (USA)*, 57(2): 281-287 (Aug 1989).

The comparative behavior of sulfur (S) and technetium (Tc) in soybean seedlings shows gross subcellular distributions to be similar for these oxyanions. More than 75% of the tissue-deposited Tc remains soluble and extractable. Differences in Tc fixation/incorporation were noted for the nuclear and chloroplast fractions of leaf and root cells. Pulse studies showed that soluble protein and nitrate reductase levels rose in response to Tc accumulation by sink leaves but not source leaves. In vitro assay of chloroplast-based S reduction and incorporation systems showed Tc to be reduced and incorporated into amino nitrogen-containing products. A hypothesis related to the metabolic behavior of Tc in plants is presented.

53543 **Technetium-99 cycling in maple trees: Characterization of changes in chemical form.** Garten, C.T. Jr. (Oak Ridge National Lab., TN (USA)); Lomax, R.D. *Health Physics (USA)*, 57(2): 299-307 (Aug 1989).

Prior field studies near an old radioactive waste disposal site at Oak Ridge, TN, indicated that following root uptake, metabolism by deciduous trees rendered 99Tc less biogeochemically mobile than expected, based on chemistry of the pertechnetate (TcO-4) anion. Subsequently, the form of technetium (Tc) in maple tree (Acer sp.) sap, leaves, wood and forest leaf litter was characterized using one or more of the following methods: dialysis, physical fractionation, chemical extraction, gel permeation chromatography, enzymatic extraction, or thin layer chromatography (TLC) on silica gel. Chromatography (Sephadex G-25) of TcO-4 incubated in vitro with tree sap showed it to behave similar to TcO-4 anion. When labeled wood and leaf tissues were processed using a tissue homogenizer, 15% and 40%, respectively, of the Tc was solubilized into phosphate buffer. Most (65% to 80%) of the solubilized Tc passing a 0.45-micron filter also passed through an ultrafiltration membrane with a nominal molecular weight cutoff of 10,000 atomic mass units (amu). A majority (72% to 80%) of the Tc in wood could be chemically removed by successive extractions with ethanol, water and weak mineral acid. These same extractants removed only 23% to 31% of the Tc from maple leaves or forest floor leaf litter. Most of the Tc in leaves and leaf litter was removed only by strongly alkaline reagents typically used to release structural polysaccharides (hemicelluloses) from plant tissues. Chromatography (Sephadex G-25) of the ethanol-water extract from wood and the alkaline extract from leaves demonstrated that Tc in these extracts was not principally TcO-4 but was complexed with molecules greater than 1000 amu. Incubations of leaf and wood homogenates with protease approximately doubled the amount of Tc released from contaminated tissues.

53544 **Life, evolution, and the pursuit of single photon sensitivity.** Bitensky, M.W. (Los Alamos National Lab., NM (USA)); Whalen, M.M.; Torney, D.C. *Cold Spring Harbor Symposia on Quantitative Biology (USA)*, : 303-311 (1988).

Evolutionary forces have designed a large family of rod and cone photoreceptors, each member of which suits the lifestyle requirements and circadian patterns of a particular species. The three-segment architecture of signal transduction is conspicuous in the biochemistry of photoreceptors and supports their demonstrated properties of extreme sensitivity, low noise levels, extended dynamic range, and light adaptation. The designs elaborated by evolution reflect a gradual process of modification, with the sequential elaboration of layers of control and refinements in control. The end results of this long evolutionary labor are the functional efficiency and dynamic range that give the rod its utility. Our conceptual problems in deriving observed rod properties from the

collective features of known rod gene products may well give way when we have learned more about the true composition and topology of the outer segment gene set and both bound and free nucleotide concentrations. The invertebrates have developed alternative solutions to the problems of photoreceptor sensitivity and wide dynamic range. The vertebrate rod represents a truly optimized way to capture and interpret low-intensity photon signals. One may anticipate, with some enthusiasm, those molecular and kinetic data that will permit an understanding of how cones differ from rods and how release from the requirement for single photon detection has shaped the design of this wavelength-specific companion photoreceptor. The utilization by evolution of the three-segment architecture of GTP-dependent signal transduction for other modalities of sensory perception, such as olfaction and gustation is certainly a reasonable and successful choice. 56 references.

5603 Chemicals Metabolism and Toxicology

53545 (AD-A-209589/1/XAB) **Determination of the acute and repeated oral toxicity of halocarbon oil, series 27-S. Interim report, December 1986-November 1987.** Kinkead, E.R.; Culpepper, B.T.; Henry, S.S.; Szotak, P.S.; Flemming, C.D. Northrop Services, Inc./Environmental Sciences, Dayton, OH (USA). Feb 1989. 60p. Available from NTIS, PC A04/MF A01.

Halocarbon 27-S (HC 27-S), a polymer of chlorotrifluoroethylene (CTFE), is used as a lubricating oil for pumps in hyperbaric chambers. Although monomeric CTFE has been shown to produce renal lesions in rats, the toxicity of CTFE polymers has not been investigated. Following a single dose of 5 g HC 27-S, no signs of toxicity were noted and no lesions observed at sacrifice 14 days following treatment. To assess the toxicity of repeated exposure to HC 27-S, three groups (n=5) of male and female rats were dosed with 2.5 g HC 27-S/kg for 7 or 21 consecutive days. Groups were sacrificed at 7, 21, and 35 days after the initial dose. Decreased water consumption and urine output were apparent in all test groups. Significant increase in fluoride excretion was noted in 24-hr urine samples collected periodically during the study. The increased fluoride burden in treated animals appeared sufficient to alter bone calcium/phosphate ratios in male but not female rats. Increased liver and kidney weights were observed in all treated rats on all assessment days. Gross liver enlargement and hepatocellular cytomegaly indicated that the liver is probably the primary target organ following repeated administration of HC 27-S.

53546 (DOE/ER/60592–T2) **Particle deposition in human and canine tracheobronchial casts: Progress report.** New York Univ. Medical Center, Tuxedo, NY (USA). 1988. 39p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER60592. Order Number DE90001152. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

To predict deposition efficiency, knowledge is required of airway morphometry and the distributions of inhaled airflow. The latter are expected to vary with flow rate and detailed measurements are needed to quantitate this parameter in the human and dog models. These data should provide essential input for the development of modifying factors to incorporate flow dependent, non-homogeneous mass transfer needed for quantitative dosimetry. Full morphometric and inhalation flow distribution measurements on the human and canine airway casts were completed in the current grant period. The work provided new quantitative data of airflow distribution in a realistic central airway cast for two species and for two different airflow patterns; steady inspiratory flow and pulsatile inspiratory flow.

53547 (ETDE-mf–0711711) **Expedemiological studies on the influence of SO_2, NO_X and air-borne dust concentrations on the incidence of in-patient children with stenosing laryngotracheitis in the Bochum city area.** Severien Labayru, J.C. Bochum Univ. (Germany, F.R.). Medizinische Fakultaet. 3 May 1988. 58p. (In German). Order Number DE90711711. Available from NTIS (US Sales Only), PC A04/MF A01.

Based on 1,200 cases of in-patient children with stenosing laryngotracheitis (pseudocroup) and some 250,000 recorded immission measurement data, the possible correlation between disease incidence and SO_2, NO_x, and air-borne dust pollution was studied while considering the space and time conditions in the Bochum city area. Space-related evaluation of exposure to SO_2 and pseudocroup incidence showed a weak positive correlation ($p<0.05$) in 3 measurement years, a negative correlation ($p<0.025$) in 1 measurement year, and no statistically significant correlation in 9 measurement years. Time-related evaluation of different 3-year periods showed at elevated SO_2 concentrations that pseudocroup case numbers were significantly higher but also lower than the expected average. No statistically significant deviation of case number was found at elevated concentrations within the overall study period of 16 years. Evaluation of time-related dependence between NO_2 exposure and pseudocroup case number showed a statistically significant higher case number at elevated concentrations in the total study period of 6 years. However, a causal connetion between both parameters could not be deduced immediately because of possible interfering factors like infection epidemiological ones and others. Time-related evaluation of NO exposure in the 3-year study period and air-borne-dust exposure in the 1-year study period showed no statistical correlation with the corresponding pseudocroup case numbers. (orig.).

53548 (ORNL/FTR–2518) **[Re-evaluation of chemical carcinogenicity]: Foreign trip report, March 7–19, 1987.** Griesemer, R.A. Oak Ridge National Lab., TN (USA). 1 Apr 1987. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89017343. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler participated in an international scientific re-evaluation of the epidemiologic and experimental evidence for the carcinogenicity of all 617 agents (chemicals, groups of chemicals, industrial processes, occupational exposures, and cultural habits) that had been previously evaluated in volumes 1–42 of the IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans. The results of the evaluations, to be published as Supplement 7 to the Monograph series, are expected to serve worldwide as the definitive lists of substances carcinogenic to humans. They should serve as the basis for international informational and regulatory efforts to prevent cancers.

53549 (ORNL/FTR–2536) **[The design and interpretation of inhalation studies in toxicology]: Foreign trip report, March 20–April 7, 1987.** Witschi, H. Oak Ridge National Lab., TN (USA). 20 Apr 1987. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89017309. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The meeting I attended in Hannover, FRG, dealt with "The Design and Interpretation of Inhalation Studies;" it was a general review of current state-of-the-art inhalation toxicology. At the University of Bern, Switzerland, I learned from Prof. Abelin about current public health problems in Switzerland. An invited seminar was presented at the Central Toxicology Laboratory of ICI, and in Newcastle-on-Type I had the opportunity to discuss my current research with Prof. P. Alexander, an internationally recognized authority in experimental cacinogenesis.

53550 (ORNL/FTR–3393) **[Bioremediation of mercury-contaminated sites]: Foreign trip report, September 9–17, 1989.** Turner, R.R. Oak Ridge National Lab., TN (USA). 27 Sep 1989. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90001248. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The purpose of this travel was to allow the traveler to (1) attend the 7th International Conference on Heavy Metals in the Environment held in Geneva, Switzerland; (2) chair two sessions (Wastewater Purification and Organometallic Compounds, respectively) of the conference; and (3) present a paper describing research [supported jointly by the Hazardous Waste Remedial Actions Program (HAZWRAP) of the US Department of Energy (DOE) and the US Environmental Protection Agency (USEPA)] on the bioremediation of mercury-contaminated sites. The title of the paper was "Volatilization, Methylation, and Demethylation of Mercury in a Mercury-Contaminated Stream." The traveler was also a co-author of another paper, "Gene Probes to Predict Responses of Aquatic Microbial Communities to Toxic Metals," which was presented by the USEPA collaborator (T. Barkay). The conference brought together international experts to present and discuss research findings on many aspects of metals in the environment and thus

provided the traveler the opportunity to interact beneficially with researchers in the subfields of mercury biogeochemistry and microbial ecology. The traveler also attended conference sessions on metals and acid deposition, groundwater, wastewater purification, and municipal solid waste. 2 refs.

53551 (PB–89-206734/XAB) **Contribution of wood smoke and motor-vehicle emissions to ambient aerosol mutagenicity.** Lewis, C.W.; Baumgardner, R.E.; Stevens, R.K.; Claxton, L.D.; Lewtas, J. Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab. Aug 1988. 6p. (EPA–600/J-88/325). Available from NTIS, PC A02/MF A01.

Pub. in Environmental Science and Technology, Vol. 22, No. 8, 968-971(Aug 1988).

A receptor-model analysis of the mutagenicity of ambient fine particles in air samples collected under EPA's Integrated Air Cancer Project has been performed. The analysis was based on multiple linear regression, using measured concentrations of inorganic chemical elements which are good indicators of likely sources of the mutagenicity. This has allowed the determination of the separate contributions made by wood smoke and mobile sources to the mutagenicity measured in a residential neighborhood in Albuquerque, NM. The results is generally consistent with the known potencies of these sources, based on source measurements.

53552 (PB–89-207161/XAB) **Analysis of air-toxics emissions, exposures, cancer risks, and controllability in five urban areas. Volume 1. Base year analysis and results.** Wilson, J.; Istvan, D.; Laich, E.; Lahre, T. Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards. Jul 1989. 88p. (EPA–450/2-89/012A). Available from NTIS, PC A05/MF A01.

This report is the first phase of a study to define the multiple-source, multiple pollutant nature of the urban air-toxics problem (also known as 'urban soup') and to discern what control measures (or combinations of measures) can best be employed to mitigate the urban air-toxics problem. The report documents the base year analysis, involving dispersion modeling of emissions data for 25 carcinogenic air toxics in five U.S. urban areas and a subsequent exposure/risk assessment to estimate aggregate cancer incidence. Aggregate (multi-source, multi-pollutant) cancer incidence (or population risk) across the 5 cities in this study averaged about 6 excess cases per million persons, ranging from about 2 to 10 in individual cities. The most-important pollutants contributing to aggregate incidence are polycyclic organic matter, 1,3-butadiene, formaldehyde and hexavalent chromium. The most-important sources are road vehicles, comfort and industrial cooling towers, chrome platers, solvent use, and fuel combustion, including wood stoves.

53553 (PB–89-207294/XAB) **Selection of a suitable extraction method for mutagenic activity from woodsmoke-impacted air particles.** Williams, R.; Pasley, T.; Warren, S.; Zweidinger, R.; Watts, R. Environmental Health Research and Testing, Inc., Research Triangle Park, NC (USA). 1988. 20p. Available from NTIS, PC A03/MF A01.

Pub. in International Jnl. of Environmental Analytical Chemistry, Vol. 34, 137-154(1988).

Extraction methods were evaluated for recovery of mutagneic activity from woodsmoke-impacted air particles. Soxhlet and sonication techniques were utilized with a variety of solvents to ascertain the effect of solvent choice, extraction methods, or dissolved gases in extraction solvents on the recovery of mutagenicity. Sonication extraction gave slightly less mass recovery than the Soxhlet method. Methanol extracted more mass than the other solvents with dichloromethane recovering the least. Dissolved gases were not found to have any effect, while mutagenicity was shown to be dependent upon solvent and extraction method. Soxhlet extraction with acetone and toluene/ethanol yielded the highest recovery of mutagenic activity; however, results indicated a solvent/solute interaction which chemically altered one or more extract components. Extraction employing dichloromethane and sonication was selected as a suitable method since this treatment appeared not to alter extracted compounds, and good recovery of mutagenicity was obtained. (Copyright (c) 1988 Gordon and Breach Science Publishers Inc.)

53554 (PB–89-214779/XAB) **Synergistic effects of nitrogen dioxide and carbon dioxide following acute inhalation exposures in rats.** Levin, B.C.; Paabo, M.; Highbarger, L.; Eller, N. National Inst. of Standards and Technology (NEL), Gaithersburg, MD (USA). Center for Fire Research. May 1989. 45p. (NISTIR–89/4105). Available from NTIS, PC A03/MF A01.

All fires occurring in air produce carbon dioxide (CO_2). Fire involving nitrogen-containing products will also generate nitrogen dioxide (NO_2), a pulmonary irritant. In Fischer 344 male rats, the LC50 (30 minute exposure plus 14 day post-exposure observation period) for NO_2 was 200 ppm (with 95% confidence limits of 43 to 51%); whereas, the LC50 for NO_2 in the presence of 5% CO_2 was 90 ppm (with 90% confidence limits ranging from 70-120 ppm). Exposure to NO_2 increased the methemoglobin (MetHb) levels in the arterial blood. At the end of the 30 minute exposures, the MetHb levels were 2-3 times higher in the animals exposed to the combination of NO_2 (200 ppm) and CO_2 (5%) than in those exposed to NO_2 only. Deaths from NO_2 were all post-exposure and occurred earlier in the presence of NO_2 plus 5% CO_2 than in the absence of the CO_2. The time of death was concentration-dependent when both gases were present. At death, evidence of hemorrage and extensive edema was observed in the lungs. The mean lung wet weight/body weight ratio from rats exposed to 200 ppm NO_2 with and without 5% CO_2 was 3-4 times that of non-exposed rats. More edema was noted with NO2 and CO_2 than with NO_2 alone.

53555 (PB–89-867451/XAB) **Biological effects and environmental fate of antifouling substances. January 1978-July 1989 (Citations from the Life Sciences Collection data base). Report for January 1978-July 1989.** National Technical Information Service, Springfield, VA (USA). Aug 1989. 84p. Available from NTISPC N01/MF N01.

This bibliography contains citations concerning the environmental effects of antifouling substances used to control biofouling and their eventual fate in the biosphere. Toxicity studies, the effects of regulations on pollution distribution, bioaccumulation and sediment accumulation, resistant organisms, and biodeterioration of antifouling substances are discussed. Antifouling materials considered include copper, nickel, and organotin compounds. Marine fouling, cooling system fouling, and antifouling paints are discussed in separate bibliographies. (Contains 152 citations fully indexed and including a title list.)

53556 (UCRL–100678) **Assessing multiple pathway exposures: Variability, uncertainty, and ignorance.** McKone, T.E. Lawrence Livermore National Lab., CA (USA). Aug 1989. 28p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8906180–2: U.S. EPA/ORNL workshop on municipal waste combustion: deposition, food chain impacts, uncertainty, and research needs, Cincinnati, OH (USA), 8-9 Jun 1989). Order Number DE90001020. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Human populations contact environmental pollutants through food, water, and air in varying amounts each day throughout a lifetime. Thus, a realistic strategy for managing the potential health risks of municipal incinerator emissions requires a comprehensive approach with adequate attention to uncertainties. Using contaminant transfers from air to food as a case study, this paper considers two important issues in exposure assessment–completeness of the exposure model and the treatment of uncertainty in exposure estimates. This case study is used to distinguish between variability (inherent randomness in data), ignorance (incomplete data and/or lack of scientific understanding) and uncertainty (the variance in exposure estimates attributable to the combination of variability and ignorance). For the air/food pathways, I explore the use of pathway exposure factors (PEFs) that combine information on environmental partitioning ("fugacity," biotransfer factors, deposition, etc.) with data on human diet, behavior patterns, and physiology into a numerical expression that links ambient air concentrations in mg/m^3 into daily exposure in mg/kg-d. Following EPA protocol, exposure expresses human contact with contaminants through the lungs, the gut wall, and skin surface. I describe and assess the uncertainty for exposure estimates of incinerator emissions through the air/milk and air/meat pathways. I consider the advantages and disadvantages of

various methods for propagating and analyzing uncertainties. 23 refs., 4 figs., 2 tabs.

53557 **Molecular characterization of somatic gene mutations arising in vivo in humans.** Albertini, R.J. (Genetics Lab., Univ. of Vermont, College of Medicine, Burlington, VT (US)); Nicklas, J.A.; O'Neill, J.P. vp of Monitoring of occupational genotoxicants. Sorsa, M.; Norppa, H. Alan R. Liss Inc., New York, NY (1986). (CONF-8506220--: Monitoring of occupational exposure to genotoxicants: a satellite symposium, Helsinki (Finland), 30 Jun - 2 jul 1985).

Hprt mutant T-cell colonies from 2 normal male individuals were studied. From individual 1, nine control wild type and thirteen hprt mutant colonies were analyzed while from individual 2, one wild type and twelve hprt mutant colonies as well as a bulk (non-mutant) culture were studied. The results of studies of hprt structural alteration sand Ti gene rearrangements in DNA of four wild type and eleven hprt mutant colonies from individual 1 have been reported elsewhere. Using the hprt probe, 3 of the mutants showed major alteration in hprt gene structure and several others showed possible changes on Southern blot analysis. The same filters as were used for the hprt Southern blots were then probed with the Ti β cDNA gene probe, Jurkat 2. A wide variety of different restriction fragments were seen on a Bam HI blot. Every Ti gene pattern except two were unique. The two pairs of duplicate Ti β gene configurations included a wild type and a hprt mutant, both of which appeared to have an unrearranged Ti β gene, and two hprt mutants which had similar or identical Ti gene rearrangements. One of these two mutants had an hprt gene structural alteration and one did not. These clearly derived from separate in vivo clones.

53558 **Application of human sperm parameters for monitoring.** Wyrobek, A.J. (Biomedical Sciences Div., Lawrence Livermore National Lab., Univ. of California, PO Box 5507, Livermore, CA (US)). vp of Monitoring of occupational genotoxicants. Sorsa, M.; Norppa, H. Alan R. Liss Inc., New York, NY (1986). (CONF-8506220--: Monitoring of occupational exposure to genotoxicants: a satellite symposium, Helsinki (Finland), 30 Jun - 2 jul 1985).

Two categories of reproductive effects of toxic exposure are critical for both the individual and the species: changes in fertility and the production of genetically or morphologically defective offspring. Measuring these effects in exposed individuals or populations is generally difficult because of the problems and limitations associated with epidemiologic studies. Some measurements of reproductive damage can be made directly in the exposed man. Here, the status of several current methods used to assess male reproductive damage are briefly reviewed and related to available studies of workplace exposures. Also, some promising new approaches for measuring chromosomal and genetic damage in sperm are described. Each method is discussed in light of mechanism, limitations for human study, and its potential relevance as an indicator of abnormal fertility or adverse reproductive outcome.

53559 **A risk assessment for selected lead-induced health effects: An example of a general methodology.** Whitfield, R.G. (Argonne National Lab., IL (USA)); Wallsten, T.S. *Risk Analysis (USA)*, 9(2): 197-207 (Jun 1989).

The research described here is part of a larger risk assessment project to aid the U.S. Environmental Protection Agency (EPA) in its review of the primary National Ambient Air Quality Standard for lead. The methodology can be applied to many situations in which a policy decision about a toxic substance is required in the face of incomplete data. Numerical results are presented for three potentially adverse lead-induced effects of interest to EPA: elevated erythrocyte protoporphyrin (EP), hemoglobin (Hb) decrement, and intelligence quotient (IQ) decrement.

53560 **The metabolism of 4,8-DiMeIQx in conventional and germ-free rats.** Knize, M.G. (Lawrence Livermore National Lab., CA (USA)); Overik, E.; Midtvedt, T.; Turteltaub, K.W.; Happe, J.A.; Gustafsson, J.A.; Felton, J.S. *Carcinogenesis (UK)*, 10(8): 1479-1484 (Aug 1989).

The aromatic amine mutagen, [^{14}C]2-amino-3,4-8-trimethylimidazo[4,5-f]quinoxaline (4,8-DiMeIQx), which is derived from cooked food, was administered to conventional and germ-free AGUS rats previously fed either a semi-synthetic diet containing the cytochrome P-450 inducer beta-naphthoflavone (BNF) or a control diet without BNF. The germ-free animals had longer fecal transit times and lower induction of 7-ethoxyresorufin-O-deethylase activity than conventional rats. Induction with BNF caused a greater percentage of the radioactivity to be excreted in the feces of both germ-free and conventional rats. Feeding BNF also caused a 4-fold induction in germ-free and a 24-fold induction in conventional rat intestinal enzyme levels. Analysis of the urinary and fecal metabolites showed no consistent differences between conventional and germ-free rats in the metabolite profile. Major metabolites were identified as 8-hydroxymethyl-DiMeIQx, N-acetyl-8-hydroxymethyl-DiMeIQx, and 3-N-dimethyl-4-hydroxy-methyl-DiMeIQx. The data from this study indicate that intestinal microflora do not play a major role in the metabolism of 4,8-DiMeIQx, but the induction of intestinal enzymes does not affect the route and rate of excretion.

5604 Other Environmental Pollutant Effects

Refer also to citation(s) 52157, 52158, 53169, 53218

53561 (AD-A-208927/4/XAB) **Biomedical studies with the free-electron laser. Final report, 1 February 1986-31 January 1988.** Berns, M.W. Beckman Laser Inst. and Medical Clinic, Irvine, CA (USA). 15 May 1989. 215p. Available from NTIS, PC A10/MF A01.

An electrostatic Van de Graff FEL was used to study the effects of infrared radiation on the synthesis of DNA and RNA in living vertebrate cells in culture. The laser was operated at wavelengths of 165 and 200 microns at power densities of 0.1 - 30 KW/sq.cm. Cells were incubated in radioactive precursors to either DNA or RNA following exposure to the FEL and analyzed by light-microscope autoradiography. The results indicated that the 200 micron wavelength inhibited DNA but not RNA synthesis in a subpopulation of cells and the 165-micron wavelength inhibited RNA synthesis and not DNA synthesis. The statistical significance for the 200 micron wavelength studies was $p = 0.05$ and for the 165 micron wavelength studies $p = 0.001 - 0.005$. Partial Contents: Delayed Retinal Effects of Frequency Doubled YAG Laser (532 nm); Tumor Destruction in Photodynamic Therapy; Comparison of Continuous Wave Lasers for Endarterectomy of Experimental Atheromas; Mechanism of Tumor Destruction Following Photodynamic Therapy with Hematoporphyrin Derivative, Chlorin, and Phthalocyanine; Phycocyanin; Laser Activation, Cytotoxic Effects, and Uptake in Human Atherosclerotic Plague; Basic Laser Physics and Tissue Interaction; Biological Studies on the Free Electron Laser; Ablation of Bone and Methacrylate by a Prototype Mid-Infrared Erbium; YAG Laser; and Corneal Healing after Excimer Laser Surface Ablation.

53562 (AD-A-208948/0/XAB) **Inhibition of nucleic acid synthesis in cells exposed to 200-micrometer radiation from the free-electron laser. Final report, 1 February 1986-31 January 1988.** Berns, M.W.; Bewley, W. Beckman Laser Inst. and Medical Clinic, Irvine, CA (USA). 1988. 4p. Available from NTIS, PC A02/MF A01.

Pub. in Photochemistry and Photobiology, Vol. 46, No. 2, 165-167(1988).

Vertebrate tissue culture cells were exposed to 200-micrometer-wavelength radiation 100 W/sq cm from a free electron laser (FEL) of the electrostatic generator type. Cell cultures demonstrated no morphological alterations but a statistically significant ($p < or = .05$) proportion of the cells exhibited inhibition of DNA synthesis. This study demonstrates the first biological effects of the FEL and the feasibility of performing biological investigations with this device.

53563 (AD-A-208951/4/XAB) **Direct gene transfer into human cultured cells facilitated by laser micropuncture of the cell membrane.** Tao, W.; Wilkinson, J.; Stanbridge, E.J.; Berns, M.W. Beckman Laser Inst. and Medical Clinic, Irvine, CA (USA). Jun 1987. 5p. Available from NTIS, PC A02/MF A01.

Pub. in Proceeding of the National Academy of Sciences, Vol. 84, 4180-4184(Jun 1987).

The selective alteration of the cellular genome by laser microbeam irradiation has been extensively applied in cell biology. We report here the use of the third harmonic (355 nm) of an yttrium-aluminum garnet laser to facilitate the direct transfer of the neo

gene into cultured human HT1080-6TG cells. The resultant transformants were selected in media containing an aminoglycoside antibiotic, G418. Integration of the neo gene into individual chromosomes and expression of the gene were demonstrated by Southern blot analyses, microcell-mediated chromosome transfer, and chromosome analyses. The stability of the integrated neo gene in the transformants was shown by a comparative growth assay in selective and nonselective media. Transformation and incorporation of the neo gene into the host genome occurred at a frequency of 8x10-4-3x10-3. This method appears to be 100-fold more efficient than the standard calcium phosphate-mediated method of DNA transfer.

53564 (AD-A–208979/5/XAB) **Activity of retinal ganglion cells following intense, nanosecond laser flashes. Final report, 1983-1986.** Glickman, R.D. Krug International, San Antonio, TX (USA). Technology Services Div. 1989. 19p. Available from NTIS, PC A03/MF A01.

Pub. in Clin. Vision Sci.; Vol. 4, No. 1, 1-18(1989).

The effects of intense, but nonlesion-producing, laser exposures of 20-ns duration were determined on the light responses and spontaneous activity of retinal ganglion cells recorded in situ from the rhesus monkey. (Following a single, 20-ns exposure centered on its receptive field, a ganglion cell produced an 'afterdischarge' of maintained action potentials). The duration of the afterdischarge depended on the diameter of the laser beam on the retina and on the beam's intensity. Laser exposures subtending 0.5 to 2.0 deg, and delivering 45 to 60% of the maximum permissible exposure, elicited afterdischarges that lasted up to 80 s. When the beam diameter was decreased to 0.25 deg, the afterdischarge was reduced to 30 s, and to less than 5 s with the 0.12-deg beam. Light sensitivity after the laser exposure recovered rapidly during the first 10 s and then more slowly, but exponentially, until it reached the preflash level. Color-opponent ganglion cells exhibited a phenomenon called 'response-reversal' after the laser exposure, presumably due to selective adaptation of a mid-wavelength cone-input. Because a 20-ns exposure, regardless of intensity, is likely to photoregenerate more than half of the available visual pigment, the effects of ganglion cell response described here are not likely to be due solely to pigment bleaching.

53565 (AD-A–208988/6/XAB) **Lack of behavioral effects in the rhesus monkey: High peak microwave pulses at 1.3 GHz.** D'Andrea, J.A.; Cobb, B.L.; de Lorge, J.O. Naval Aerospace Medical Inst., Pensacola, FL (USA). 1989. 13p. Available from NTIS, PC A03/MF A01.

Pub. in Bioelectromagnetics, Vol. 10, 65-76(1989).

The current safety standards for radiofrequency and microwave exposure do not limit the peak power of microwave pulses for general or occupational exposures. While some biological effects, primarily the auditory effect, depend on pulsed microwaves, hazards associated with very high peak-power microwave pulses in the absence of whole-body heating are unknown. Five rhesus monkeys, Macaca mulatta, were exposed to peak-power densitites of 131.8 W/sq cm (RMS) while performing a time-related behavioral task. The task was composed of a multiple schedule of reinforcement consisting of three distinct behavioral components: inter-response time, time discrimination, and fixed interval. Trained monkeys performed the multiple schedule during exposure to 1.3-GHz pulses at low pulse-repetition rates (2-32 Hz). No significant change was observed in any behavior during irradiation as compared to sham-irradiation sessions. Generalization of these findings to experimental results with higher peak-power densities, other pulse rates, different carrier frequencies, or other behaviors is limited.

53566 (PB–89-202717/XAB) **Noise-reduction effectiveness of resilient rail fasteners on steel solid web stringer elevated structures. Volume 1. Final report.** Nelson, J.T.; Wilson, G.P. New York City Transit Authority, Brooklyn, NY (USA). Mar 1989. 108p. Available from NTIS, PC A06/MF A01.

See also Volume 2, PB–89-202725.

Under the sponsorship of the Urban Mass Transportation Administration's Technical Assistance program, the New York City Transit Authority (NYCTA) studies the noise-reduction effectiveness of various resilient rail fasteners for steel elevated structures. The study included field and laboratory tests, and limited theoretical modeling to identify and optimize those characteristics most effective in reducing noise, while meeting criteria for rail stability. Top-plate bending resonance in the 500-700 Hz frequency range may be a significant factor in reducing the vibration-isolation effectiveness of resilient rail fasteners. The standing-wave elastomer resonance (thickness mode) of resilient fasteners does not appear to be significant to wayside noise reduction at 500 Hz or lower frequencies for the type of fasteners considered.

53567 (PB–89-202725/XAB) **Noise-reduction effectiveness of resilient rail fasteners on steel solid web stringer elevated structures. Volume 2. Final report.** Nelson, J.T.; Wilson, G.P. New York City Transit Authority, Brooklyn, NY (USA). Mar 1989. 416p. Available from NTIS, PC A18/MF A01.

See also Volume 1, PB–89-202717. Portions of this document are not fully legible.

The New York City Transit Authority studied the noise-reduction effectiveness of various resilient rail fasteners for steel elevated structures. The study included field and laboratory tests, and limited theoretical modeling to identify and optimize those characteristics most effective in reducing noise, while meeting criteria for rail stability. Top-plate bending resonance in the 500-700 Hz frequency range may be a significant factor in reducing the vibration isolation effectiveness of resilient rail fasteners. The standing wave elastomer resonance (thickness mode) of resilient fasteners does not appear to be significant to wayside noise reduction at 500 Hz or lower frequencies for the type of fasteners considered.

57 HEALTH AND SAFETY

Refer also to citation(s) 53244, 53437

58 GEOSCIENCES

5801 Geology and Hydrology

Refer also to citation(s) 51736, 51737, 52648, 53221, 53222, 53223, 53751

53568 (LA–11679-PR) **Water supply at Los Alamos during 1988: Progress report.** Purtymun, W.D.; Maes, M.N.; McLin, S.G. Los Alamos National Lab., NM (USA). Oct 1989. 37p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. Order Number DE90000871. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The municipal and industrial water supply during 1988 was 1459 $\times 10^6$ gal. from wells in three fields, and 34 $\times$ 10{ 6} gal. from the spring gallery in Water Canyon. About 2.4 $\times 10^6$ gal. of water from the Guaje Reservoir and 1.4 $\times 10^6$ gal. from the Los Alamos Reservoir were used for irrigation; thus, the total water usage in 1988 was about 1497 $\times 10^6$ gal. The water supply was satisfactory in that production met the demand and water quality in the distribution system was in compliance with state and federal regulations. 22 refs., 6 figs., 6 tabs.

53569 (SAND–89-1177) **Geotechnology publications and related reports: A bibliography, January–December 1988.** Tolendino, C. (ed.). Sandia National Labs., Albuquerque, NM (USA). Aug 1989. 66p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE90000896. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This document is a collection of abstracts of papers prepared as part of the Sandia programs in the GeoEnergy Technology Department and other closely related research. Areas of technology represented are resource access (drilling, blasting), resource extraction (enhanced recovery) and geodiagnostics. More basic work in the Geosciences is in a separate chapter. Industry programs and Technology Transfer constitute a final section. That section also includes our geotechnical support to DOE on the Strategic Petroleum Reserve in which we work closely with the SPR site contractor. 65 refs.

5802 Geophysics

Refer also to citation(s) 52872, 53126, 53128

53570 (NUREG/CR–3252) **New England seismotectonic study activities during fiscal year 1980.** Barosh, P.J.; Smith, P.V. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Boston Coll., Weston, MA (USA). Weston Observatory. Sep 1989. 227p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A11/MF A01 - GPO - OSTI.

The Fiscal Year 1980 New England Seismotectonic Program consisted of thirty separate but coordinated studies covering New England and adjacent Canada, which are described in this report. Those studies can be grouped into eight separate categories. (1) Regional and local earthquake activity were studied and seismic hazard estimates made, an earthquake catalogue was developed for the period 1534–1977, and a seismometer array was installed in the Moodus, Connecticut seismic area. (2) The causes of seismicity along the northern Fall Zone from New Jersey to Connecticut were investigated. (3) The level of activity of faults in the Champlain-Hudson area were investigated. (4) Geologic mapping of fault systems was conducted in the Adirondack Mountains. (5) Geophysical studies were carried out in southern New England. (6) Geologic mapping was accomplished at selected locations to study Mesozoic and younger tectonics. (7) Brittle fractures in bedrock were mapped within areas of seismicity to determine if there is a relationship between these features and earthquakes. (8) Vertical crustal movements along the coast of Maine were studied. 94 refs., 88 figs., 34 tabs.

53571 (PNL-SA–17154) **The design and use of an electrically driven core sampler capable of obtaining marine sediment cores through dense substrates.** Word, J.Q.; Ward, J.A.; Coley, J.A.; Gibson, C.L. Pacific Northwest Lab., Richland, WA (USA). Jun 1989. 6p. Sponsored by U.S. Department of Defense. DOE Contract AC06-76RL01830. (CONF-8909128–3: Oceans '89 conference, Seattle, WA (USA), 18-21 Sep 1989). Order Number DE90001393. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Two new core samplers were designed and constructed to collect marine sediment as part of a US Army Corps of Engineers (USACE) program in Oakland Harbor, Oakland, California. A vibratory-hammer core and a vibratory-hammer split core were developed that can obtain sediment cores through dense substrates. The corers were used during three sampling cruises and found to be effective in obtaining relatively undisturbed samples from normally compacted to hard-packed coastal and estuarine sediment. 1 ref., 2 figs.

53572 (UCRL–101709) **A study of the difference between gravimetric and gamma-gamma density near the surface in northern Yucca Flat.** Hearst, J.R.; Burkhard, N.R. Lawrence Livermore National Lab., CA (USA). [1989]. 50p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8909163–2: 5. symposium on containment of underground nuclear detonations, Santa Barbara, CA (USA), 19-21 Sep 1989). Order Number DE89017886. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Although the mean and median of the difference between average density from 50 to 200 m below the surface in 43 holes in northern Yucca Flat computed from a density log and that computed from borehole gravity using the measured free air gradient is very close to zero, the range of values is very large. Many individual values of the difference are significantly different from zero. When the gravimetric density is computed using a free air gradient calculated from the surface gravity on an irregular but approximately 300 m grid, the mean and median of the difference between gravimetric and gamma-gamma density is slightly closer to zero than when the measured free air gradient is used. The range of values is not significantly decreased. Proposed explanations for this large range fall into two categories: anomalies in the gravity field or its horizontal derivative at the sites with large difference range, causing changes in the free air gradient or the near-surface gravimetric density, and mechanisms that affect the bulk density near the borehole, causing changes in the gamma-gamma density. We have investigated many proposed explanations and have found no single mechanism that is consistent with the data. These results indicate that the choice of method of determining free air gradient causes no significant change in the difference between near-surface gamma density and gravimetric density, and that there is no obvious method of eliminating the range. Because calculation from surface gravity is much less expensive than tower measurement, and there is no evidence that it is less accurate, we consider it the logical method for routinely obtaining free air gradient until some evidence is found to suggest the contrary. We are attempting to optimize the calculational procedure. The tradeoff is between the accuracy of the calculated free air gradient and the amount of surface gravity data required. 8 refs., 19 figs., 1 tab.

53573 (WHC-SA–0600) **Transmission of low-magnitude seismic excitation into Hanford Site structures.** Weiner, E.O. Westinghouse Hanford Co., Richland, WA (USA). Aug 1989. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. (CONF-8910192–10: 2. DOE natural phenomena hazards mitigation conference, Knoxville, TN (USA), 3-5 Oct 1989). Order Number DE90001238. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Several Hanford Site buildings were analyzed using simplified models to gain insight as to what extent the free field motion of a small-magnitude earthquake is transmitted into building structures as a result of soil-structure interaction effects. Building selection included the Plutonium Processing Plant, B-Plant and the Fast Flux Test Facility containment which represented a variety of stiffnesses, weights, and embedments. An artificial time history for the free field has a peak response at 13 Hz. This motion represents a median for magnitude 4 and 4.5 earthquakes, respectively. Floor response spectra were compared with results from analyses to design basis ground motions using the same structural models. Considerable attenuation of the small-magnitude free-field motion was found in the case of stiff, deeply embedded structures. This attenuation is attributed to kinematic interaction in addition to attenuation with depth in the free field. Even with such attenuation, there are exceptions where small magnitude responses exceed design basis responses. They are generally associated with 10 to 20 Hz modes with vertical motion. 6 refs., 6 figs., 1 tab.

5803 Mineralogy, Petrology, and Rock Mechanics

Refer also to citation(s) 53571

53574 (SAND–89-1197) **Quasi-static and dynamic mechanical properties of a granite and a sandstone.** Olsson, W.A. Sandia National Labs., Albuquerque, NM (USA). Sep 1989. 10p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC04-76DP00789. Order Number DE89016963. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The quasi-static failure criteria, elastic constants, and p-wave velocities have been determined for a granite and a sandstone in which blasting experiments are being carried out by the Advanced Technology Division (6258). In addition, the dynamic strength of the granite was measured using a Kolsky bar. Both rocks show a linear increase in strength with increasing confining pressure. The dynamic strength of the granite is as much as 330% greater than the quasi-static value. The strength of the granite was also dependent on the angle between the foliation and the loading direction. There was a 20% difference in the p-wave velocity between that measured parallel to and perpendicular to the bedding in the sandstone. 4 refs., 4 figs., 5 tabs.

5804 Geochemistry

Refer also to citation(s) 53150

53575 (ENEA-RT-TIB–85-4) **Rare earths in environmental and geological samples: Neutron activation analysis.** Moauro, A.; Madaro, M. ENEA, Casaccia (Italy). Dipt. Tecnologie Intersettoriali di Base. Feb 1985. 14p. (In Italian). Order Number DE89793116. Available from NTIS (US Sales Only), PC A03/MF A01.

Neutron activation analysis allows the determination of rare earth elements (REEs) with a sensitivity much higher than non-nuclear methods. In this paper, this technique was applied to determine REEs in environmental samples, such as marine suspended particulate matter and sea, lake and river sediments. The importance of

lanthanides in the environmental field is due to the fact that some REEs, because of their nearly identical physical-chemical behavior, can simulate the environmental behavior of actinides, generated by activation or fission processes. Am(3) can be simulated by Eu(3) and Nd(3), that can simulate also Cm(3). As regards REEs in geological studies, their distribution and fractionation in rocks provide information about the genesis and the evolution of the rocks themselves. Some data relevant to Kenya rocks are presented.

64 PHYSICS I

Refer also to citation(s) 53132, 54047

6401 Astrophysics and Cosmology

Refer also to citation(s) 53667, 53675, 53751, 53970

53576 (ESA-SP–285-VOL-1, pp. 8) **Computer simulations of cosmic-ray diffusion near supernova remnant shock waves.** Max, C.E. (California Univ., Berkeley (USA)); Zachary, A.L.; Arons, J. European Space Agency, 75 - Paris (France). Jan 1989. (ETN–89-94475;CONF-8809173–: International workshop on reconnection in space plasma, Potsdam (German Democratic Republic), 5-9 Sep 1988). In *Proceedings of an International School and Workshop on Plasma Astrophysics, volume 1.* Available from NTIS, PC A18/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 45 US dollars or 80 Dutch guilders.

A plasma simulation model was used to study the resonant interactions between streaming cosmic-ray ions and a self-consistent spectrum of Alfven waves, such as might exist in the interstellar medium upstream of a supernova remnant shock wave. The computational model is a hybrid one, in which the background interstellar medium is an MHD fluid and the cosmic-rays are discrete kinetic particles. The particle sources for the electromagnetic fields are obtained by averaging over the fast cyclotron motions. When the perturbed magnetic field is larger than 10 percent of the background field, the macro- and microphysics are no longer correctly predicted by quasi-linear theory. The particles are trapped by the waves and show sharp jumps in their pitch-angles relative to the background magnetic field, and the effective ninety-degree scattering time for diffusion parallel to the background magnetic field is reduced to between 5 and 30 cyclotron periods. Simulation results suggest that Type 1 supernova remnants may be the principal sites of cosmic ray acceleration.

53577 (ESA-SP–285-VOL-1, pp. 4) **The electron beam instability revisited: Growth above and below f sub p.** Cairns, I.H. European Space Agency, 75 - Paris (France). Jan 1989. (ETN–89-94475;CONF-8809173–: International workshop on reconnection in space plasma, Potsdam (German Democratic Republic), 5-9 Sep 1988). In *Proceedings of an International School and Workshop on Plasma Astrophysics, volume 1.* Available from NTIS, PC A18/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 45 US dollars or 80 Dutch guilders.

The growth of electrostatic waves near the plasma frequency (fp) due to an unstable electron beam is investigated by solving the unmagnetized electrostatic dispersion equation numerically. The numerical solutions are compared with analytic theories for reactive (or fluid-type) and kinetic versions of the beam instability, and for the O'Neil/Malmberg connection of the beam and Langmuir modes. Conditions for growth significantly above or below fp are given. Three general results are found: (1) The unstable waves do not grow on a mode with Langmuir dispersion except in the limit of a very dilute beam with growth on O'Neil/Malmberg's connected mode; (2) The properties of the unstable mode depend strongly on beam parameters such as beam density, speed and temperature; and (3) The frequency of maximum growth frequently lies significantly above or below fp, and differs significantly from that predicted by the Langmuir dispersion relation. Results imply important consequences for theories of strong turbulence and nonlinear wave-wave processes, and observational identification of fp from observed wave frequencies.

53578 (ESA-SP–285-VOL-1, pp. 5) **Dissipation of Alfven waves in solar coronal arches.** Sudan, R.N.; Similon, P.L. European Space Agency, 75 - Paris (France). Jan 1989. (ETN–89-94475;CONF-8809173–: International workshop on reconnection in space plasma, Potsdam (German Democratic Republic), 5-9 Sep 1988). In *Proceedings of an International School and Workshop on Plasma Astrophysics, volume 1.* Available from NTIS, PC A18/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 45 US dollars or 80 Dutch guilders.

The physical mechanism by which mechanical energy is delivered to and absorbed by the solar corona is discussed. A set of MHD equations for analyzing the slow evolution of the magnetic field and the fast time of Alfven waves is presented. Alfven wave dissipation is treated. It is shown that the slow motion of the feet of coronal arches leads to irregular magnetic fields and that Alfven waves propagating in the irregular magnetic structure are dissipated through filamentation of the wave packet that generates short scales necessary for efficient dissipation.

53579 (ESA-SP–285-VOL-1, pp. 117-124) **Relativistic shocks in electron-positron plasmas and polar cap accretion onto neutron stars: Two non-linear problems in astrophysical plasma physics.** Arons, J. European Space Agency, 75 - Paris (France). Jan 1989. (ETN–89-94475;CONF-8809173–: International workshop on reconnection in space plasma, Potsdam (German Democratic Republic), 5-9 Sep 1988). In *Proceedings of an International School and Workshop on Plasma Astrophysics, volume 1.* Available from NTIS, PC A18/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 45 US dollars or 80 Dutch guilders.

Particle simulations and theory of relativistic shock waves in an e+ e- plasma simulation are outlined. Magnetic reflection of particles is an essential role in the shock structure. Instability of the reflected particles in the shock front produces intense extraordinary mode radiation. Such shocks are candidates for the particle accelerator in plerions and in extragalactic jets only if the upstream Poynting flux composes no more than 10 percent of the total. Analytical and numerical studies of radiation dominated accretion onto the magnetic poles of neutron stars are summarized. The upper limit to the photon luminosity depends upon magnetic confinement, not upon the dragging of photons into the star. Numerical solutions show the plasma forms large scale photon bubbles. The percolative loss of radiation controls the pressure and therefore the limits of magnetic confinement. Loss of magnetic confinement through resistive interchange instability is suggested as a means of generating TeV to PeV voltage drops along the magnetic field.

53580 (ESA-SP–285-VOL-1, pp. 137-141) **Relativistic MHD from two-fluid hydrodynamics (TFHD).** Kennel, C.F. (Abastumani Astrophysical Observatory, Georgia, USSR); Gedalin, M.E.; Lominadze, J.G. European Space Agency, 75 - Paris (France). Jan 1989. (ETN–89-94475;CONF-8809173–: International workshop on reconnection in space plasma, Potsdam (German Democratic Republic), 5-9 Sep 1988). In *Proceedings of an International School and Workshop on Plasma Astrophysics, volume 1.* Available from NTIS, PC A18/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 45 US dollars or 80 Dutch guilders.

It is shown that the expected MHD equations may be derived from the relativistic two-fluid hydrodynamical equations, when current velocities are assumed negligible when compared to the mass flow velocity. It is found that MHD does not work in the inner part of the pulsar magnetosphere at radii smaller than that of the light cylinder. The plasma has a very anisotropic pressure and one can expect the firehose instability to develop from only the light cylinder. However, MHD works in the outer parts of the magnetosphere.

53581 (ESA-SP–285-VOL-1, pp. 153-155) **Shock-associated plasma density fluctuations in the interstellar medium.** Spangler, S.R. European Space Agency, 75 - Paris (France). Jan 1989. (ETN–89-94475;CONF-8809173–: International workshop on reconnection in space plasma, Potsdam (German Democratic Republic), 5-9 Sep 1988). In *Proceedings of an International School and Workshop on Plasma Astrophysics, volume 1.* Available from NTIS, PC A18/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 45 US dollars or 80 Dutch guilders.

Theories of diffuse shock acceleration of the cosmic rays that predict that there should be regions of intense Alfven waves both

upstream and downstream of the shock front are considered. Observations of similar waves near solar system shock waves show that they produce substantial density fluctuations. Such density fluctuations might produce observable scattering of radio waves. Observations which searched for angular broadening or blurring of radio sources whose lines of sight pass close to or through supernova remnants are discussed. No definite cases of remnant-associated scattering are detected. However, the source CL 4, which is viewed through the Cygnus Loop supernova remnant, may be such an object and merits further observation.

53582 (ESA-SP–285-VOL-1, pp. 239-242) **Effects of unequal particle number densities on Alfven waves.** Cairns, I.H. European Space Agency, 75 - Paris (France). Jan 1989. (ETN–89-94475;CONF-8809173–: International workshop on reconnection in space plasma, Potsdam (German Democratic Republic), 5-9 Sep 1988). In *Proceedings of an International School and Workshop on Plasma Astrophysics, volume 1.* Available from NTIS, PC A18/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 45 US dollars or 80 Dutch guilders.

Analytic plasma theory and numerical solutions of the dispersion equation are used to show that the assumption that the linear properties of the waves are determined by a charge-neutral plasma in the absence of the nonthermal particles, while the nonthermal particles cause growth or additional damping superposed onto the background, is seriously flawed even for stable plasmas. Even when the nonthermal particles do not contribute significantly to the dispersion equation, unequal thermal electron and ion number densities (due to the presence of the nonthermal particles) may cause fundamental low wave number modifications to the Alfven modes, including the creation of a new resonance and severely modified dispersion. These results are found for both cold and warm plasmas. Previous work on Alfven waves should be reevaluated in view of these results.

53583 (ESA-SP–285-VOL-1, pp. 243-246) **A new model of PeV gamma-ray sources.** Smith, I.A.; Katz, J.I. European Space Agency, 75 - Paris (France). Jan 1989. (ETN–89-94475;CONF-8809173–: International workshop on reconnection in space plasma, Potsdam (German Democratic Republic), 5-9 Sep 1988). In *Proceedings of an International School and Workshop on Plasma Astrophysics, volume 1.* Available from NTIS, PC A18/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 45 US dollars or 80 Dutch guilders.

A model for the proton acceleration connected with accreting X-ray binaries is proposed. Acceleration is assumed to occur on the closed (dipole) field lines of the neutron star where the density is low and collisional losses of the energetic protons are small. Protons can be mirrored at the poles and become trapped, affording time for them to be accelerated gradually. Eventually, high energy protons escape by diffusing onto open field lines. It is postulated that potential energy of the matter accreting on the open field lines is transferred to Alfven waves that accelerate the protons on the closed field lines. Proton synchrotron radiation may be detectable from the GeV gamma-ray region to the infrared.

53584 (ESA-SP–285-VOL-1, pp. 247-250) **Neutron starquakes and the nature of gamma-ray bursts.** Madau, P.; Blaes, O.; Blandford, R.D.; Goldreich, P. European Space Agency, 75 - Paris (France). Jan 1989. (ETN–89-94475;CONF-8809173–: International workshop on reconnection in space plasma, Potsdam (German Democratic Republic), 5-9 Sep 1988). In *Proceedings of an International School and Workshop on Plasma Astrophysics, volume 1.* Available from NTIS, PC A18/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 45 US dollars or 80 Dutch guilders.

The possibility that gamma-ray bursts originate from quakes deep in the solid crust of a neutron star is investigated. Seismic waves are radiated if shear stress is relieved by brittle fracture. However they cannot propagate directly to the surface but are temporarily trapped below a reflecting layer. The shaking of the stellar surface couples the seismic waves to Alfven waves which propagate out into the magnetosphere. The crust-magnetosphere transmission coefficient strongly increases with wave frequency and magnetic field strength. Alfven wave luminosities sufficient to power galactic gamma-ray bursts are possible if magnetic fields greater than 100 billion G cover at least part of the stellar surface. As the Alfven waves propagate out into the low density magnetosphere, they become increasingly charge starved, thereby accelerating particles to relativistic energies.

53585 (ESA-SP–285-VOL-1, pp. 251-254) **Are supernova remnants quasi-parallel or quasi-perpendicular accelerators.** Spangler, S.R.; Leckband, J.A.; Cairns, I.H. European Space Agency, 75 - Paris (France). Jan 1989. (ETN–89-94475;CONF-8809173–: International workshop on reconnection in space plasma, Potsdam (German Democratic Republic), 5-9 Sep 1988). In *Proceedings of an International School and Workshop on Plasma Astrophysics, volume 1.* Available from NTIS, PC A18/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 45 US dollars or 80 Dutch guilders.

Observations of shock waves in the solar system which show a pronounced difference in the plasma wave and particle environment depending on whether the shock is propagating along or perpendicular to the interplanetary magnetic field are discussed. Theories for particle acceleration developed for quasi-parallel and quasi-perpendicular shocks, when extended to the interstellar medium suggest that the relativistic electrons in radio supernova remnants are accelerated by either the Q parallel or Q perpendicular mechanisms. A model for the galactic magnetic field and published maps of supernova remnants were used to search for a dependence of structure on the angle Phi. Results show no tendency for the remnants as a whole to favor the relationship expected for either mechanism, although individual sources resemble model remnants of one or the other acceleration process.

53586 (ESA-SP–285-VOL-1, pp. 281-283) **Global kinetic theory of astrophysical jets.** Chang, T. European Space Agency, 75 - Paris (France). Jan 1989. (ETN–89-94475;CONF-8809173–: International workshop on reconnection in space plasma, Potsdam (German Democratic Republic), 5-9 Sep 1988). In *Proceedings of an International School and Workshop on Plasma Astrophysics, volume 1.* Available from NTIS, PC A18/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 45 US dollars or 80 Dutch guilders.

It is suggested that an astrophysical plasma stream flowing outward from a central object along an open magnetic field line with decreasing field strength generally has anisotropic velocity distributions. The electron distribution function of this type of plasma streams contains a thermally populated region and a stretched out high energy tail (or jet-like) region collimated in the outward direction of the magnetic field line. The argument is based on a global, collisional, kinetic theory. Because the kinetic jets are always pointed along the outward direction of the field lines, they are automatically collimated and assume the geometries dictated by the magnetic field. This result should be useful in the understanding of the basic structures of astrophysical objects as extragalactic radio jets, stellar winds, the solar wind, planetary polar winds, and galactic jets (e.g., SS433).

53587 (ESA-SP–285-VOL-1, pp. 285-289) **Nonlinear oblique whistlers: Their relevance to nonthermal coupling of ions and electrons in accretion flow and supercritical quasi-perpendicular collisionless shocks.** Chang, T. European Space Agency, 75 - Paris (France). Jan 1989. (ETN–89-94475;CONF-8809173–: International workshop on reconnection in space plasma, Potsdam (German Democratic Republic), 5-9 Sep 1988). In *Proceedings of an International School and Workshop on Plasma Astrophysics, volume 1.* Available from NTIS, PC A18/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 45 US dollars or 80 Dutch guilders.

It is demonstrated that oblique whistlers may be effective in coupling and energizing plasma populations during accretion flow onto massive central objects such as black holes. These plasma collective modes could be excited by inverse ion-populations in perpendicular velocity space such as the ring-like and loss-cone type of distributions, or cross-field drifts induced by the gravitational and magnetic fields, reflection across high-Mach number collisionless shocks, density and/or magnetic field gradients. Nonlinear and turbulent states of these plasma collective modes can accelerate the electrons to large energies. It is suggested that the same nonlinear plasma modes may play a central role in the description of the structure of supercritical quasi-perpendicular collisionless shocks.

53588 (ESA-SP–285-VOL-1, pp. 381-384) **On the existence and stability of intermediate shocks.** Coppi, P.S. (California Univ., Los Angeles (SUA)); Blandford, R.D.; Kennel, C.F. European Space Agency, 75 - Paris (France). Jan 1989. (ETN–89-94475;CONF-8809173–: International workshop on reconnection in space plasma, Potsdam (German Democratic Republic), 5-9 Sep 1988). In *Proceedings of an International School and Workshop on Plasma Astrophysics, volume 1.* Available from NTIS, PC A18/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 45 US dollars or 80 Dutch guilders.

The question of the existence of intermediate shock waves is examined. It is pointed out that the MHD Rankine-Hugoniot conditions allow up to four types of intermediate shock discontinuity and that one of these is evolutionary. Numerical simulations, analyses of spacecraft data, and theoretical arguments suggest that intermediate shocks can form and be stable. Intermediate discontinuities are classified graphically and the preshock conditions under which they can exist are elucidated. No definitive conclusion is reached concerning the physical reality of intermediate shocks.

53589 (FNAL/C–89/188-T) **Gamma ray lines from dark matter annihilation.** Giudice, G.F. Fermi National Accelerator Lab., Batavia, IL (USA). Aug 1989. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-8905222–1: Topical seminar on astrophysics and particle physics, San Miniato (Italy), 8-12 May 1989). Order Number DE90000779. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

If direct annihilation of dark matter particles into a pair of photons occurs in the galactic halo, a narrow γ-ray line can be discovered at future γ-ray detectors sensitive to the GeV region. The signals predicted by different dark matter candidates are analyzed. 16 refs., 3 figs.

53590 (INIS-mf–12006, pp. 117-118) **Trebbin - another meteorite with a complex irradiation history?.** Heusser, G. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

The stone meteorite Trebbin has a deficit in short lived cosmogenic radionuclides like (^{57}Co $CT_{1/2}$ = 271.8 d), ^{54}Mn ($T_{1/2}$ = 312.5 d), ^{22}Na ($T_{1/2}$ = 2.60 a), but is normal in its content of long lived ^{26}Al ($T_{1/2}$ = 0.716 Ma). This finding can best be explained by a break-up of the meteoroid into a small body that the nucleonic cascade could hardly develop. This should have happened one to three years before its fall on Earth. (orig.).

53591 (INIS-mf–12006, pp. 118) **Assemblage, composition, and possible thermal history of Fremdlinge in the Ca-Al-rich inclusion 477B from the Vigarano chondrite.** Caillet, C. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.)); El Goresy, A.; Zinner, E.K.; Goldstein, J.; Velde, D. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Ferropericlase-bearing Fremdlinge were discoverd in a Ca-Al-rich inclusion in the Vigarano chondrite (CV3). The coexisting metal indicates fast cooling to 500^{0}C. Measurements of oxygen isotopes of coexisting spinels indicate the lowest δ^{18}O and δ^{17}O values ever encountered in CAI spinels. (orig.).

53592 (INIS-mf–12006, pp. 140) **Maximum energies of particles, which are accelerated by supernova remnant shockwaves in a stellar wind.** Biermann, P.L. (Max-Planck-Institut fuer Radioastronomie, Bonn (Germany, F.R.)); Voelk, H.J. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Diffusive shock acceleration, balanced by adiabatic losses, leads readily to particle energies $\geq 10^{15}$ eV in the case of a supernova freely expanding into a stellar wind cavity. (orig.).

53593 (INIS-mf–12006, pp. 140) **The structure of weak cosmic ray mediated shocks.** Zank, G.P. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.)); Webb, G.M.; McKenzie, J.F. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

The self-consistent non-linear structure of weak shocks modified by cosmic rays has been studied and the stability of such shocks has been considered. The structure of the Halley bow shock has been discussed in terms of this model. (orig.).

53594 (INIS-mf–12006, pp. 140-141) **A cosmic ray driven plasma instability.** Zank, G.P. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

It is shown that the forward propagating sub-Alfvenic mode is unstable on wavelength scales greater than 1 par sec. The role of this instability in astrophysical models is considered. (orig.).

53595 (INIS-mf–12006, pp. 141) **Hydrodynamic turbulence and shock waves in the hot phase of ISM.** Fedorenko, V.N. (AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.); Markiewicz, W.J. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Published in summary form only. PRIMARY COSMIC RADIATION/alfven waves; ABSORPTION; WAVE PROPAGATION; SCATTERING; TURBULENCE; MULTI-PHOTON PROCESSES; MAGNETOHYDRODYNAMICS; SHOCK WAVES; HOT PLASMA; INTERSTELLAR SPACE; ENERGY TRANSFER

53596 (IPNO-TH–87-66) **Bogomol'nyi bounds for cosmic strings.** Comtet, A.; Gibbons, G.W. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. Sep 1987. 20p. Order Number DE90713773. Available from NTIS (US Sales Only), PC A03/MF A01.

We establish Bogomol'nyi inequalities for the deficit angle of some cylindrically symmetric asymptotically local flat (CALF) spacetimes containing cosmic strings. These results prove the stability against arbitrary cylindrical deformations of those configurations which saturate the bound. Such configurations satisfy first order equations which can, in some cases, be solved exactly.

53597 (IYaF–89-23) **Magnetic field generation by acoustic oscillations in solar atmosphere.** Ryutov, D.D.; Ryutova, M.P. AN SSSR, Novosibirsk (USSR). Inst. Yadernoj Fiziki. 1989. 9p. (In Russian). Order Number DE90606054. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

MN-10066.

The role of acoustic waves in plasma current excitation and magnetic field generation in the Sun atmosphere is considered. Equations describing the force effecting the electron gas due to waves and equations determining the magnetic field evolution are derived. 5 refs.; 2 figs.

53598 (LAPP-TH–220-88) **Weakly interacting massive particles and stellar structure.** Bouquet, A.; Kaplan, J.; Martin, F. Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules. 1988. 38p. Order Number DE90713777. Available from NTIS (US Sales Only), PC A03/MF A01.

The existence of weakly interacting massive particles (WIMPs) may solve both the dark matter problem and the solar neutrino problem. Such particles affect the energy transport in the stellar cores and change the stellar structure. We present the results of an analytic approximation to compute these effects in a self-consistent way. These results can be applied to many different stars, but we focus on the decrease of the ^{8}B neutrino flux in the case of the Sun.

53599 (LA-UR–89-863) **The softest Einstein AGN [active galactic nuclei].** Cordova, F.A.; Kartje, J.; Mason, K.O.; Mittaz, J.P.D. Los Alamos National Lab., NM (USA). [1989]. 10p. Sponsored by U.S. DOE Defense Programs; National Aeronautics and Space Administration. DOE Contract W-7405-ENG-36. (CONF-891127–1: Einstein to AXAF conference, Cambridge, MA (USA),

Nov 1989). Order Number DE89009389. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We have undertaken a coarse spectral study to find the softest sources detected with the Imaging Proportional Counter (IPC) on the Einstein Observatory. Of the nearly 7700 IPC sources, 226 have color ratios that make them candidate "ultrasoft" sources; of these, 83 have small enough errors that we can say with confidence that they have a spectral component similar to those of the white dwarfs Sirius and HZ 43, nearby stars such as α Cen and Procyon, and typical "polar" cataclysmic variables. By means of catalog searches and ground-based optical and radio observations we have thus far identified 96 of the 226 candidate soft sources; 37 of them are active galactic nuclei (AGN). In the more selective subset of 83 sources, 47 have been identified, 12 of them with AGN. The list of 47 identifications is given in Cordova et al. For one QSO in our sample, E0132.8–411, we are able to fit the pulse-height data to a power-law model and obtain a best fit for the energy spectral index of 2. $2_{-0.4}^{+0.6}$. For the remainder of the AGN in the higher confidence sample we are able to infer on the basis of their x-ray colors that they have a similar spectral component. Two-thirds of the AGN are detected below 0.5 keV only, while the remainder evidence a flatter spectral component in addition to the ultra-soft component. 14 refs., 5 figs.

53600 (LA-UR–89-3200) **Thermonuclear Runaway model.** Sparks, W.M.; Kutter, G.S.; Starrfield, S.; Truran, J.W. Los Alamos National Lab., NM (USA). [1989]. 13p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. (CONF-8906225–1: Physics of classical novae: IAU colloquium no. 122, Madrid (Spain), 27-30 Jun 1989). Order Number DE90000690. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The nova outburst requires an energy source that is energetic enough to eject material and is able to recur. The Thermonuclear Runaway (TNR) model, coupled with the binary nature of nova systems satisfies these conditions. The white dwarf/red dwarf binary nature of novae was first recognized as a necessary conditions by Kraft. The small separation characteristic of novae systems allows the cool, red secondary to overflow is Roche lobe. In the absence of strong, funneling magnetic fields, the angular momentum of this material prevents it from falling directly onto the primary, and it first forms a disk around the white dwarf. This material is eventually accreted from the disk onto the white dwarf. As the thickness of this hydrogen-rich layer increases, the degenerate matter at the base reaches a temperature that is high enough to initiate thermonuclear fusion of hydrogen. Thermonuclear energy release increases the temperature which in turn increases the energy generation rate. Because the material is degenerate, the pressure does not increase with temperature, which normally allows a star to adjust itself to a steady nuclear burning rate. Thus the temperature and nuclear energy generation increase and a TNR results. When the temperature reaches the Fermi temperature, degeneracy is lifted and the rapid pressure increase causes material expansion. The hydrogen-rich material either is ejected or consumed by nuclear burning, and the white dwarf returns to its pre-outburst state. The external source of hydrogen fuel from the secondary allows the while process to repeat. 43 refs., 8 figs.

53601 (LA-UR–89-3288) **A quasi-economic role for lunar science.** Jones, E.M. Los Alamos National Lab., NM (USA). [1989]. 12p. Sponsored by National Aeronautics and Space Administration. DOE Contract W-7405-ENG-36. (CONF-8910229–1: 40. congress of the International Astronautical Federation, Malaga (Spain), 7-13 Oct 1989). Order Number DE90000679. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In broad economic terms, the development of lunar products will begin with a sequence of technology, production, and delivery demonstrations which will have to precede the emergence of markets. Economically viable products will tend to be those for which the sum of production and transport costs are lower for lunar suppliers than for terrestrial suppliers. As long as lunar production costs exceed terrestrial production costs – as will be the case for most lunar products until such time as lunar development has reached a mature stage – the most viable industries will be those producing low-tech products for lunar markets. The scale of initial lunar markets will depend on the size of a lunar base and/or its rate of growth. For a given level of public support, maximum base size can be achieved through the conduct, at the base, of a vigorous program of scientific and engineering research making use of as much local production and as many permanently-resident support staff as feasible. 5 refs.

53602 (MPE-PREPRINT–131) **The 158 micron (CII) mapping of the galactic center molecular clouds.** Genzel, R.; Stacey, G.J.; Townes, C.H.; Poglitsch, A.; Geis, N. Max-Planck-Institut fuer Physik und Astrophysik, Garching (Germany, F.R.). Oct 1988. 8p. (ETN–89-94392). Available from Fachinformationszentrum Karlsruhe, 7514 Eggenstein-Leopoldshafen 2, Federal Republic of Germany.

Maps are made with a 55 sec resolution in the region of the curved, thermal filaments and the 20 to 50 km per sec molecular clouds in Sgr A. The emission is spatially well correlated with the radio continuum in the filaments. The large intensity radiation excludes shock as the origin of the ionization.

53603 (MPE-PREPRINT–133) **Strong, spatially extended CO 7 to 6 emission from luminous cloud cores: W51 and DR21.** Jaffe, D.T.; Genzel, R.; Harris, A.I.; Lugten, J.B.; Stacey, G.J.; Stutzki, J. Max-Planck-Institut fuer Physik und Astrophysik, Garching (Germany, F.R.). Oct 1988. 38p. (ETN–89-94394). Available from Fachinformationszentrum Karlsruhe, 7514 Eggenstein-Leopoldshafen 2, Federal Republic of Germany.

It is concluded that three distinct molecular cloud components contribute to the CO 7 vs 6 emission, including the warm, dynamically active material which accounts for 75 percent of the velocity integrated CO emission from the two sources; a warm, quiescent material associated with the HII regions in each source; and a cool (20 to 40K) quiescent gas, which overlies some of the hot material.

53604 (N–89-23547, pp. 367-382) **The space particle environment.** Vampola, A.L. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. May 1989. (NASA-CP–3035-PT-2;L–16575-PT-2;NAS–1.55:3035-PT-2;CONF-8806434–: NASA/SDIO space environmental effects on materials workshop, Hampton, VA (USA), 28 Jun - 1 jul 1988). In *NASA/SDIO Space Environmental Effects on Materials Workshop, part 2.* Available from NTIS, PC A12/MF A01.

The energetic charged particle environment in the Earth's magnetosphere was studied. An overview is provided of trapped particle morphology, the geometry of the trapping regions, the radiation environmental models, the current status of these models, and future modelling requirements.

53605 (N–89-23547, pp. 495-509) **An overview of charging environments.** Gabriel, S.B.; Garrett, H.B. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. May 1989. (NASA-CP–3035-PT-2;L–16575-PT-2;NAS–1.55:3035-PT-2;CONF-8806434–: NASA/SDIO space environmental effects on materials workshop, Hampton, VA (USA), 28 Jun - 1 jul 1988). In *NASA/SDIO Space Environmental Effects on Materials Workshop, part 2.* Available from NTIS, PC A12/MF A01.

A brief synopsis of the natural environments that play a role in spacecraft charging is presented. Environments that cause both surface and internal charging are discussed along with the mechanisms involved. The geosynchronous and low altitude regions of the Earth's magnetosphere/ionosphere are considered and simple descriptions of each environment presented. As material properties are critical to the charging process, definition of material properties important to charging, which can be affected by the environment, are also described. Several space experiments are proposed that would help fill the gaps in the knowledge of the performance of materials in a charging environment.

53606 (N–89-24142) **Direct electron-pair production by high energy heavy charged particles. Final report, April 15, 1988-15 October 1989.** Takahashi, Y.; Gregory, J.C.; Hayashi, T.; Dong, B.L. Alabama Univ., Huntsville, AL (USA). May 1989. 20p. (NASA-CR–184958;NAS–1.26:184958). Available from NTIS, PC A03/MF A01.

Direct electron pain production via virtual photons by moving charged particles is a unique electro-magnetic process having a substantial dependence on energy. Most electro-magnetic processes, including transition radiation, cease to be sensitive to the incident energy above 10 TeV/AMU. Thus, it is expected, that upon

establishment of cross section and detection efficiency of this process, it may provide a new energy measuring technique above 10 TeV/AMU. Three accelerator exposures of emulsion chambers designed for measurements of direct electron-pains were performed. The objectives of the investigation were to provide the fundamental cross-section data in emulsion stacks to find the best-fit theoretical model, and to provide a calibration of measurements of direct electron-pairs in emulsion chamber configurations. This paper reports the design of the emulsion chambers, accelerator experiments, microscope measurements, and related considerations for future improvements of the measurements, and for possible applications to high energy cosmic ray experiments. Also discussed are the results from scanning 56m of emulsion tracks at 1200x magnification so that scanning efficiency is optimized. Measurements of the delta-ray range spectrum were also performed for much shorter track lengths, but with sufficiently large statistics in the number of measured delta-rays.

53607 (N–89-24162) **Solar and stellar coronal plasmas. Semiannual report Nos. 12-17, 1 May 1986-30 April 1989.** Golub, L. Smithsonian Institution, Cambridge, MA (USA). Smithsonian Astrophysical Observatory. Apr 1989. 177p. (NASA-CR–184909;NAS–1.26:184909). Available from NTIS, PC A09/MF A01.

Progress in observational, theoretical, and radio studies of coronal plasmas is summarized. Specifically work completed in the area of solar and stellar magnetic fields, related photospheric phenomena and the relationships between magnetism, rotation, coronal and chromospheric emission in solar-like stars is described. Also outlined are theoretical studies carried out in the following areas, among others: (1) neutral beams as the dominant energy transport mechanism in two ribbon-flares; (2) magneto hydrodynamic and circuit models for filament eruptions; and (3) studies of radio emission mechanisms in transient events. Finally, radio observations designed for coronal activity studies of the sun and of solar-type coronae are described. A bibliography of publications and talks is provided along with reprints of selected articles.

53608 (N–89-24233) **The Allegheny Observatory search for planetary systems. Final technical report, 1980-1988.** Gatewood, G.D. Pittsburgh Univ., PA (USA). Apr 1989. 12p. (NASA-CR–184990;NAS–1.26:184990). Available from NTIS, PC A03/MF A01.

The accomplishments of the observatory's search for planetary systems are summarized. Among these were the construction, implementation, and regular use of the Multichannel Astrometric Photometer (MAP), and the design, fabrication and use of the second largest refractor objective built since 1950. The MAP parallax and planetary observing programs are described. Various developments concerning alternate solid state photodetectors and telescope instrumentation are summarized. The extreme accuracy of the system is described in relation to a study of the position and velocity of the members of the open cluster Upgren 1. The binary star system stringently tests the theory of stellar evolution since it is composed of an evolved giant F5 III and a subgiant F5 IV star. A study that attempts to measure the luminosities, surface temperatures, and masses of these stars is discussed.

53609 (N–89-24251) **Redistribution in astrophysically important hydrogen lines.** Cooper, J.; Ballagh, R.J.; Hubeny, I. Joint Inst. for Lab. Astrophysics, Boulder, CO (USA). May 1989. 8p. (NASA-CR–181375;NAS–1.26:181375). Available from NTIS, PC A02/MF A01.

Under typical solar chromospheric conditions for hydrogen radiators, strong collisions due to both electrons and ions are well separated in time, so that a binary collision theory for collisional redistribution is applicable. However, a simple impact approximation may not be used, but rather a unified type theory is required in which frequency dependent line shape parameters are used to describe both impact and quasi-static regions of the spectrum. In addition, correlated terms which describe absorption and emission during a collision are important, and, in fact, without correlated terms describing both transfer of excitation and emission during the same collision unphysical predictions (such as negative intensities) would be obtained. In this paper theory is specifically developed for the coupled Lyman-alpha, Lyman-beta, Hydrogen-alpha system, and equations of statistical equilibrium and absorption and emission coefficients are given. All correlated events are examined and emission during a collision is found to be important in the line wings. Stimulated emission and absorption is also included within a broadband approximation. The major approximation is to ignore lower state interaction. It is found that for Lyman-beta Raman-coupling with Hydrogen-alpha occurs and the overall scattering of radiation in the line wings is mostly coherent. In contrast, for Hydrogen-alpha, incoherent redistribution due to lower state radiative decay (which occurs even in the absence of collisions) is found to dominate the coherent scattering. Finally, in the Lyman series the dominant incoherent contribution is associated with cascade transitions and inelastic collisions between different principal quantum states.

53610 (N–89-24260) **Rapid fitting of particle cascade development data from X-ray film densitometry measurements.** Roberts, E.; Benson, C.M.; Fountain, W.F. National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center. Jun 1989. 18p. (NASA-TM–100368;NAS–1.15:100368). Available from NTIS, PC A03/MF A01.

A semiautomatic method of fitting transition curves to X-ray film optical density measurements of electromagnetic particle cascades is described. Several hundred singly and multiple interacting cosmic ray events from the JACEE 8 balloon flights were analyzed using this procedure. In addition to greatly increased speed compared to the previous manual method, the semiautomatic method offers increased accuracy through maximum likelihood fitting.

53611 (N–89-25079) **IUE investigations of SN 1987A. Semiannual status report, August 1988-February 1989.** Kirshner, R.P. Harvard Coll. Observatory, Cambridge, MA (USA). May 1989. 36p. (NASA-CR–184973;NAS–1.26:184973). Available from NTIS, PC A03/MF A01.

IUE observations of the SN 1987A began shortly after the discovery and have been frequent through 1988 and 1989, using the fine error sensor for photometry, low dispersion spectra for the supernova spectrum, and high dispersion observations for the interstellar medium when the supernova was bright and for circumstellar gas surrounding the supernova as the initial event faded. The UV data were very useful in determining which star exploded, assessing the ionizing pulse produced as the shock hit the surface of the star, and in constraining the stellar evolution that preceded the explosion through observations of a circumstellar shell.

53612 (ORNL/FTR–2747) **[Terrestrial space radiation and its effects]: Foreign trip report, October 10–25, 1987.** Fry, R.J.M. Oak Ridge National Lab., TN (USA). 6 Nov 1987. 23p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89017297. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This NATO ASI Workshop was planned to inform graduate students about: radiation environments in space, the dosimetry involved, the formulation of models to predict environments, the prediction of solar flares, the potential health effects of exposure below the magnetosphere, within the magnetosphere and in deep space, the effects of HZE particles, the possibilities of interactions between microgravity and radiation and risk estimates and radiation protection. The faculty consisted of 10 workers from Europe and 9 from the US. The students ranged from graduate students to fairly senior scientists who had an interest in such an interdisciplinary workshop. The "students" came from Belgium, England, France, Germany, Greece, South Africa, Spain, Switzerland, Turkey, and the USA. The workshop consisted of formal lectures by the faculty, panel discussions led by a faculty member and presentations by students. My role was to present lectures on radiation effects on tissues, radiation induced cancer risk estimates of both non-stochastic and stochastic effects and to report on how NCRP Scientific Committee 75, which I chaired, derived the new radiation protection guidelines for space workers and astronauts.

53613 (PB–89-207393/XAB) **Solar-Geophysical Data Number 537, May 1989. Part 1 (prompt reports). Data for April, March 1989, and late data.** Coffey, H.E. National Geophysical Data Center, Boulder, CO (USA). Jul 1987. 151p. (SGD–537-PT-1). Available from NTIS, PC A08/MF A01.

See also Part 2, PB–89-173401 and PB–89-173041.

Solar data are presented for March and April, 1989. The data include sunspot activity indices; solar flares in the H-alpha line; solar radio emissions at 3, 10, 21, and 43 cm; and mean solar magnetic fields.

53614 (PB–89-207401/XAB) **Solar-Geophysical Data Number 537, May 1989. Part 2 (comprehensive reports). Data for November 1988 and miscellaneous.** Coffey, H.E. National Geophysical Data Center, Boulder, CO (USA). Jul 1987. 96p. (SGD–537-PT-2). Available from NTIS, PC A05/MF A01.

See also PB–89-207393.

Solar data are presented for November 1988. The data include solar flares in the H-alpha line; solar radio bursts at fixed frequencies; interplanetary solar particles and plasma; solar x-ray radiation as seen from the GOES-7 artificial satellite; mass ejections from the sun; and active prominences and filaments.

53615 (RRK–89-14) **Light propagation and the distance-redshift relation in a realistic inhomogeneous universe.** Futamase, Toshifumi; Sasaki, Misao. Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics. May 1989. 25p. Order Number DE90710101. Available from NTIS (US Sales Only), PC A03/MF A01.

We investigate the propagation of light rays in a clumpy universe constructed by cosmological version of the post-Newtonian approximation. We show that the linear approximation to the propagation equations is valid in the region z < or approx 1 even if the density contrast is much larger than unity. Based on a general order-of-magnitude statisfical consideration, we argue that the linear approximation is still valid for z < or approx 1. Then we give a general formula for the distance-redshift relation in a clumpy universe and derive an explicit expression for a simplified situation in which the effect of the gravitational potential of inhomogeneities dominates. In the light of the derived relation we discuss the validity of the Dyer-Roeder distance. Furthermore, we consider a simple model of an inhomogeneous universe and investigate statistical properties of light rays. We find that the result of this specific example also supports the validity of the linear approximation. (author).

53616 **Evolution of cosmic string networks.** Albrecht, A. (National Aeronautics and Space Administration/Fermilab Astrophysics Center, Fermi National Accelerator Laboratory, Batavia, Illinois 60510 (US)); Turok, N. *Physical Review [Section] D: Particles and Fields (USA),* 40(4): 973-1001 (15 Aug 1989).

A discussion of the evolution and observable consequences of a network of cosmic strings is given. A simple model for the evolution of the string network is presented and related to the statistical mechanics of string networks. The model predicts the long-string density throughout the history of the Universe from a single parameter, which we calculate in radiation-era simulations. The statistical mechanics arguments indicate a particular "thermal" form for the spectrum of loops chopped off the network. Detailed numerical simulations of string networks in expanding backgrounds are performed to test the model. Consequences for large-scale structure, the microwave and gravity-wave backgrounds, nucleosynthesis, and gravitational lensing are calculated.

53617 **Stress-energy tensors for vector fields outside a static black hole.** Barrios, F.A. (Department of Physics, University of Cincinnati, Cincinnati, Ohio 45221 (US)); Vaz, C. *Physical Review [Section] D: Particles and Fields (USA),* 40(4): 1340-1343 (15 Aug 1989).

We obtain new, approximate stress-energy tensors to describe gauge fields in the neighborhood of a Schwarzschild black hole. We assume that the coefficient of $\nabla^2 R$ in the trace anomaly is correctly given by ζ-function regularization. Our approximation differs from that of Page and of Brown and Ottewill and relies upon a new, improved ansatz for the form of the stress-energy tensor in the ultrastatic optical metric of the black hole. The Israel-Hartle-Hawking thermal tensor is constructed to be regular on the horizon and possess the correct asymptotic behavior. Our approximation of Unruh's tensor is likewise constructed to be regular on the future horizon and exhibit a luminosity which agrees with Page's numerically obtained value. Geometric expressions for the approximate tensors are given, and the approximate energy density of the thermal tensor on the horizon is compared with recent numerical estimates.

53618 **Fermions in an Aharonov-Bohm field and cosmic strings.** Gerbert, P.d.S. (Center for Theoretical Physics, Laboratory for Nuclear Science dge, Massachusetts 02139 (US)). *Physical Review [Section] D: Particles and Fields (USA),* 40(4): 1346-1349 (15 Aug 1989).

The scattering of fermions by an infinitely thin flux tube is governed by a Dirac Hamiltonian that requires specification of a one-parameter self-adjoint extension. This Aharonov-Bohm scenario arises generically for cosmic strings. In particular for some range of the extension parameter the string can bind fermions.

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53619 (AD-A–208943/1/XAB) **Production of very energetic electrons in a discrete aurora. Technical report.** Swift, D.W.; Gorney, D.J. Aerospace Corp., El Segundo, CA (USA). Laboratory Operations. 26 Apr 1989. 21p. (TR–0088(3940-06)-7). Available from NTIS, PC A03/MF A01.

Data are presented showing that acceleration of electrons to energies in excess of 100 keV sometimes occurs on field lines associated with discrete auroral arcs. Velocity distributions suggest that acceleration is in directions primarily perpendicular to the magnetic field. The examples studied in the S3-3 data set indicate that the process can occur in the altitude range from the topside ionosphere to 5500 km. The favored explanation is that the field-aligned beam excites upper hybrid waves when it interacts with the dense ionospheric plasma. The waves efficiently scatter the beam both in energy and pitch angle.

53620 (AD-A–209063/7/XAB) **Inverse scattering: Ionospheric structure determination. Final technical report, 1 July 1979-30 June 1980.** Cohen, J.M. Pennsylvania Univ., Philadelphia, PA (USA). Dept. of Physics. Aug 1980. 45p. Available from NTIS, PC A03/MF A01.

A paper entitled 'Curved Space Scattering' was sent to AFOSR. The abstracts of the paper and report contain statements of the research accomplished. In addition, following problems were studied: the Kanal-Moses variational principle was used to treat the synthetic data discussed in the report listed in 1.1. It was found that if the initial trial function is within 10% of the actual result, then the K-M variational principle gives the result to better than 1%. The results of Kay were generalized for n-poles in such a way that practical applications are possible, e.g., to the ionosphere. To test the method, the 4- and 10-pole cases are being studied before treating the 100-pole case.

53621 (AD-A–209251/8/XAB) **Ionospheric variability. Final report, October 1985-October 1988.** Paul, A.K. Naval Ocean Systems Center, San Diego, CA (USA). Mar 1989. 13p. (NOSC/TR–1277). Available from NTIS, PC A03/MF A01.

This report summarizes the results of a study of short-term variations of the ionosphere. The digital ionograms used in this analysis were recorded at Brighton, Colorado, many of them at a high rate of 12 ionograms per hour and faster. The results show that oscillations of the electron-density distribution take place in the F region with varying amplitudes and with periods of a fraction of an hour. The oscillations are coupled with varying tilts. Rapid changes, mainly of the electron density, are also observed at E-layer heights and many records indicate that the echoes come from tilted sporadic-E patches with relatively small dimensions.

53622 (AD-A–209348/2/XAB) **Auroral E-fields from DE-1 and -2 at magnetically conjugate points.** Weimer, D.R. Regis Coll., Weston, MA (USA). Research Center. 1988. 13p. (SCIENTIFIC–4). Available from NTIS, PC A03/MF A01.

Pub. in Advanced Space Research, Vol. 8, No. 9, 9373-9384(1988).

The results of studies of the electric-field measurements from the two Dynamics Explorer satellites are reviewed. There are times at which DE-2 measured electric fields at the auroral ionosphere while DE-1 obtained nearly simultaneous measurement at a higher altitude on the same magnetic field lines. When these electric fields are mapped to a common altitude, it is found that the large-scale electric fields are similar, but the small-scale electric fields have a larger amplitude at the higher altitude. Through the use of Fourier

analysis it is shown that these results are evidence for a magnetic field-aligned potential drop between the two satellites. While these results were made possible by the satellites' altitude separation, it is also possible to take advantage of the fact that the satellites may pass through the same geomagnetic location with a time separation. This was useful for confirming that sinusoidal electric-field oscillations which were detected near one conjunction were due to spatial rather than temporal variations, since similar oscillations were found at the same location at different times. The observed spatial oscillations can be explained by a simple model of magnetosphere-ionosphere coupling.

53623 (AD-A–209542/0/XAB) **Electric fields in earth orbital space. Final report.** Pfitzer, K.A. McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA). May 1989. 30p. Available from NTIS, PC A03/MF A01.

During the last few years the author has worked on the entry of solar wind into the magnetosphere and on the control the interplanetary magnetic field (IMF) has on the magnetosphere. Correlative data conclusively prove that both the solar wind and the IMF exert considerable influence on magnetospheric processes, and the magnetospheric substorm in particular. The work on this subject may be roughly divided into two parts, particle entry and representation of the interaction of the IMF with the magnetosphere. Particle entry is discussed first. The author has quantitatively determined where on the magnetopause that low energy (solar wind) charged particles can gain entry to the magnetosphere.

53624 (ESA-SP–285-VOL-2, pp. 217-221) **Magnetotail reconnection, MHD theory and simulations.** Birn, J. (Ruhr Univ., Bochum (Germany, F.R.)); Hesse, M.; Schindler, K. European Space Agency, 75 - Paris (France). Jan 1989. (ETN–89-94476;CONF-8809173–: International workshop on reconnection in space plasma, Potsdam (German Democratic Republic), 5-9 Sep 1988). In *Proceedings of an International School and Workshop on Reconnection in Space Plasma, volume 2.* Available from NTIS, PC A15/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 45 US dollars or 80 Dutch guilders.

Magnetotail reconnection leading to plasmoid formation and ejection is discussed, emphasizing three-dimensional structures and deviations from earlier imposed symmetries, based on MHD simulations and topological considerations. In general, the separation of the plasmoid takes a finite amount of time. During this stage the plasmoid is characterized by filamentary structures of interwoven flux tubes with different topological connections.

53625 (ESA-SP–285-VOL-2, pp. 241-248) **Broadband electrostatic waves as a consequence of magnetotail reconnection.** Ashour-Abdalla, M.; Schriver, D. European Space Agency, 75 - Paris (France). Jan 1989. (ETN–89-94476;CONF-8809173–: International workshop on reconnection in space plasma, Potsdam (German Democratic Republic), 5-9 Sep 1988). In *Proceedings of an International School and Workshop on Reconnection in Space Plasma, volume 2.* Available from NTIS, PC A15/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 45 US dollars or 80 Dutch guilders.

One and two-dimensional particle stimulations are used to study ion beam driven instabilities within the plasma sheet boundary layer (PSBL) and the consequences these instabilities have in terms of plasma heating. It shown that when cold lobe plasma convects into the PSBL and interacts with the ion beams, two wave modes can be driven unstable, the electron acoustic and ion-ion two stream instabilities; these waves heat the cold electrons and cold ions close to plasma sheet temperatures.

53626 (ESA-SP–285-VOL-2, pp. 263-268) **Flux transfer events: Reconnection without separators.** Hesse, M. (Ruhr Univ., Bochum (Germany, F.R.)); Birn, J.; Schindler, K. European Space Agency, 75 - Paris (France). Jan 1989. (ETN–89-94476;CONF-8809173–: International workshop on reconnection in space plasma, Potsdam (German Democratic Republic), 5-9 Sep 1988). In *Proceedings of an International School and Workshop on Reconnection in Space Plasma, volume 2.* Available from NTIS, PC A15/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 45 US dollars or 80 Dutch guilders.

A topological analysis of a simple model magnetic field of a perturbation at the magnetopause modeling an apparent flux transfer event is presented. It is shown that a localized perturbation at the magnetopause can in principle open a closed magnetosphere by establishing magnetic connections across the magnetopause. Although the model field exhibits neutral points, these are not involved in the magnetic connection of the flux tubes. The topological substructure of a localized perturbation is analyzed in a simpler configuration. The presence of both signs of the magnetic field component normal to the magnetopause leads to a linkage of topologically different flux tubes, described as a flux knot, and a filamentary substructure of field lines of different topological types which becomes increasingly complicated for decreasing magnetic shear at the magnetopause.

53627 (ESA-SP–285-VOL-2, pp. 269-274) **Multiple X line reconnection at the dayside magnetopause.** Lee, L.C. European Space Agency, 75 - Paris (France). Jan 1989. (ETN–89-94476;CONF-8809173–: International workshop on reconnection in space plasma, Potsdam (German Democratic Republic), 5-9 Sep 1988). In *Proceedings of an International School and Workshop on Reconnection in Space Plasma, volume 2.* Available from NTIS, PC A15/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 45 US dollars or 80 Dutch guilders.

Studies on magnetic reconnection are reviewed. The multiple X line reconnection model for the flux transfer events; the criterion for the transition from the single X line to the multiple X line reconnection; a global simulation of the dayside magnetopause reconnection; a particle simulation of single X line reconnection and multiple X line reconnection; a patchy reconnection mechanism; and a mechanism for the generation of cusp-region hydromagnetic waves are discussed.

53628 (N–89-23547, pp. 569-572) **Trapped particle flux models at NSSDC/WDC-A-R/S.** Bilitza, D.; Sawyer, D.M.; King, J.H. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. May 1989. (NASA-CP–3035-PT-2;L–16575-PT-2;NAS–1.55:3035-PT-2;CONF-8806434–: NASA/SDIO space environmental effects on materials workshop, Hampton, VA (USA), 28 Jun - 1 jul 1988). In *NASA/SDIO Space Environmental Effects on Materials Workshop, part 2.* Available from NTIS, PC A12/MF A01.

The data needed in the future for trapped particle modeling are summarized. A short summary of past and future modeling activities and a list of satellite data that have not yet been considered in the modeling efforts is included.

53629 **Suprathermal electrons at Earth's bow shock.** Gosling, J.T. (Los Alamos National Laboratory, Los Alamos, New Mexico (US)); Thomsen, M.F.; Bame, S.J.; Russell, C.T. *Journal of Geophysical Research (USA),* 94(A8): 10011-10026 (1 Aug 1989).

A hot, suprathermal population of electrons is often present near the Earth's bow shock. The overall morphology of this hot population as observed with the Los Alamos/Garching fast plasma experiments on ISEE 1 and 2 in the energy range from 1 to 20 keV is much as described previously by others working primarily with more energetic particle measurements. In particular, at energies below 20 keV the flux of suprathermal electrons is most intense immediately downstream from the shock and decreases in intensity with increasing penetration into the magnetosheath. Upstream fluxes of electrons in this energy range are generally considerably weaker than are the downstream fluxes. The major new results from our ISEE measurements are as follows: (1) The suprathermal electrons are commonly found downstream from perpendicular and quasi-perpendicular portions of the shock but not downstream from quasi-parallel portions. (2) The suprathermal electron spectrum extends smoothly out of the shocked solar wind spectrum generally as a power law in energy with an exponent in the range from −3 to −4. (3) Angular distributions for the suprathermal electrons are generally isotropic immediately downstream of the shock ramp, but an anisotropy perpendicular to the magnetic field usually develops with increasing penetration into the magnetosheath. (4) Suprathermal electrons are often first observed within the shock layer itself as a field-aligned beam escaping upstream.

53630 Ion reflection and downstream thermalization at the quasi-parallel bow shock. Gosling, J.T. (Los Alamos National Laboratory, Los Alamos, New Mexico (US)); Thomsen, M.F.; Bame, S.J.; Russell, C.T. *Journal of Geophysical Research (USA)*, 94(A8): 10027-10038 (1 Aug 1989).

It is well known that for sufficiently high Mach numbers (typically $M_f > 2$) ion reflections is the primary process by which ion energy dissipation is initiated at quasi-perpendicular, collisionless shocks in space. In this paper we present evidence from ISEE 2 measurements that coherent ion reflection is also often an important element of the ion energy dissipation process at high Mach numer, quasi-parallel shocks. Such coherent reflection is not evident in a number of published hybrid simulations of quasi-parallel shocks wherein the dissipation process appears to be associated primarily with incoherent scattering of solar wind ions in the upstream and downstream wave fields. However, such reflection is present in other simulation results. The main evidence for coherent ion reflection as an important element in achieving dissipation at quasi-parallel shocks is the following: (1) A cold secondary (to the solar wind) beam of ions is often observed within the ramp of the shock where the magnetic field intensity rises precipitously and where the major electron heating occurs. Typically this secondary beam of ions has a velocity space position roughly consistent with specular reflection of a portion of the solar wind ions incident on the shock. (2) Downstream from the shock, a relatively dense and cool core ion population is typically observed, accompanied by either multiple ion bunches or, more commonly, a suprathermal ion shell. (These populations are in addition to the extremely hot, tenous diffuse ion which appear nearly ubiquitously both upstream and downstream from the shock.) The downstream core and shell (or bunches) are believed to represent directly transmitted solar wind ions and reflected and later scattered ions, respectively, with the motions of the latter population accounting for a large fraction of the ion energy dissipated at the shock.

53631 Dynamics of a plasma expanding into a uniform magnetic field. Gisler, G. (Los Alamos National Laboratory, Los Alamos, New Mexico (US)); Lemons, D.S. *Journal of Geophysical Research (USA)*, 94(A8): 10145-10150 (1 Aug 1989).

A heuristic model of an energetic plasma expanding into an initially uniform magnetic field is presented. In this model the plasma is cylindrically shaped, perfectly diamagnetic, and allowed to expand freely in the direction of the magnetic field. It results in a time evolution of the cylindrical radius described by Airy functions and parameterized by the plasma β. For instance, the maximum extent of the radius scales as $\beta^{1/3}$ while the maximum radial deceleration scales as $\beta^{-1/3}$. Time evolution and scaling are compared both with other models and with two-dimensional electromagnetic particle simulations. A spherically symmetric model is also found to agree well with the simulations and results in simpler expressions for the maximum radius and maximum radial deceleration. The larger deceleration obtained in these models, as compared with models that ignore the axial expansion, would shift toward longer wavelengths the peak growth of the instability thought to be responsible for the field-aligned structures seen in the Active Magnetospheric Particle Tracer Explorers (AMPTE) magnetotail releases. © American Geophysical Union 1989

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Refer also to citation(s) 52585, 52674, 52677, 52906, 53678, 53905, 53955, 53958, 54000

53632 (AD-A–209082/7/XAB) **Quantum-electrodynamical approach to multiphoton ionization in the high-intensity field.** Guo, D.S .; Aberg, T. Oregon Univ., Eugene, OR (USA). Dept. of Physics. Dec 1988. 16p. Available from NTIS, PC A03/MF A01.

Pub. in Jnl. of Physics A, Vol. 21, 4577-4591(1988).

The development of high-power lasers has made it possible to achieve light intensities of the order of one atomic unit. At these field strengths relativistic effects become important. It is thus of interest to study multiphoton ionization from the point of view of quantum electrodynamics (QED). In recent work Filipowicz (1985) obtained the solution of the Dirac equation for an electron interacting with a quantized electromagnetic plane wave. He also discussed the non-quantum limit of this solution. The authros here solve the Dirac equation for an electron interacting with a quantized and elliptically polarized electromagnetic field. The use the solution to obtain a relativistic S-matrix amplitude for multiphoton ionization in the high-intensity limit. Its non-relativistic limit is also derived and is used to construct a multiphoton transition-rate formula which is compared with previous results.

53633 (AD-A–209343/3/XAB) **Photodetachment cross sections of negative halogen ions in discharge media.** Wang, W.C.; Lee, L.C. San Diego State Univ., CA (USA). Dept. of Electrical and Computer Engineering. 1988. 9p. Available from NTIS, PC A02/MF A01.

Pub. in Phys. D: Applied Phys. Vol. 21, 675-682(1988).

Photodetachment of negative halogen ions occurs in the atmosphere and in discharge systems. The photodetachment cross section of negative halogen ions are generally of interest for the studies of laser and plasma physics. Laser-induced increases of discharge current were observed in the discharge media containing various halogen compounds (F_2, HF, HCl, Cl_2, HBr, CH_3Br, CH_3I and CH_2I_2) in N_2. The increase of transient current were attributed to the photodetachment of negative ions in the discharge media. On the basis of general considerations, the negative ions present in the discharge are assumed to be the atomic halogen negative ions. Photodetachment cross sections were determined from the current increases as a function of laser flux. Photodetachment cross sections of F-, Cl-, Br- and I- are (0.75, 2.5, 3.3 and 7.0) x 10^{-17} sq cm at 193 nm and (0.6, 1.0, 1.5 and 3.0) x 10^{-17} sq cm at 248 nm, respectively. These data are compared with the earlier results of negative-ion-beam experiments and theoretical calculations.

53634 (AD-A–209360/7/XAB) **Broadening and shifting of the Raman Q branch of HD.** Rosasco, G.J.; May, A.D.; Hurst, W.S.; Petway, L.B.; Smyth, K.C. National Inst. of Standards and Technology, Gaithersburg, MD (USA). 15 Feb 1989. 11p. Available from NTIS, PC A03/MF A01.

Pub. in Jnl. of Chemical Physics, Vol. 90, No. 4, 2115-2124(15 Feb 1989).

The line broadening and shifting of the vibrational Q branch in pure HD has was measured for transitions J = 0 to 3 at room temperature over the density range 0.8 to 10.6 amagat. The shifting and broadening coefficients were determined with an uncertainty of + or - .0002/cm/amaget, which now provides a discriminating test for various semiclassical and quantal theoretical calculations. The line broadening coefficients are compared with linewidth data from other spectroscopic branches and with measurements of the rates of state-to-state rotational energy transfer. Use of an exponential gap law for the rates of rotational energy transfer allows estimates to be made of the contributions to the linewidths from rotationally inelastic, elastic vibrational dephasing, and elastic reorientation processes. This analysis suggests that rotational energy transfer occurs approximately 30% faster in v = 1 than in v = 0.

53635 (AD-A–209466/2/XAB) **State-resolved cross sections for rotationally inelastic collisions of NH_2(x2B1 state) with helium.** Dagdigian, P.J. Johns Hopkins Univ., Baltimore, MD (USA). Dept. of Chemistry. 1 Mar 1989. 11p. Available from NTIS, PC A03/MF A01.

Pub. in Jnl. of Chemical Physics, Vol. 90, No. 5, 2617-2625(1 Mar 1989).

Integral cross sections for rotational transitions from the lowest orthorotational level (zero 0,0) of Amidogen (NH_2) induced by collisions with helium have been measured in a crossed beam experiment. A pulsed supersonic beam of rotationally cold NH_2 was produced by 193 nm photolysis of a dilute mixture of ammonia in argon seed gas at the tip of a nozzle; the helium target was also prepared as a pulsed beam. The final rotational state populations (without spin-state resolution) in the Ka = 0 and 1 manifolds of NH_2 were interrogated in the collision zone by dye laser fluorescence excitation in the A2A1 yields X2B1 reverse band system. Because of the rotational selection rules in the band system, it was not possible to put the cross sections for the two Ka manifolds on the same scale. Within a given Ka manifold, there is a marked preference for collisional transitions with the smallest DeltaN change. These experimental results are compared to calculated close-coupling rotationally inelastic cross sections for H_2O (zero 0,0 state)-helium collisions.

53636 (AD-A–209522/2/XAB) **Traps for neutral atoms. Annual summary report, 1 September 1987-31 August 1988.** Pritchard, D.E. Massachusetts Inst. of Tech., Cambridge, MA (USA). Research Lab. of Electronics. 7 Jun 1989. 5p. Available from NTIS, PC A02/MF A01.

The author concentrated on radio-frequency resonance experiments on magnetically trapped neutral atoms. R.F. resonance of trapped atoms is valuable for at least three reasons: as a high-resolution diagnostic of the atoms' individual and collective behavior, as a tool to selectively manipulate the magnetic quantum states of the trapped atoms, and potentially for ultrahigh-resolution spectroscopy of isolated atomic systems. Following the successful demonstration of r.f. induced transitions on trapped neutral atoms, he proceeded to increase the number (approx. x 10^{10}) and confinement time ($tau_{1/e}$ = 30 minutes) of trapped sodium atoms so that he had sufficient signal to time to perform r.f. resonance measurements as a diagnostic of the effects of Doppler cooling on the atoms' energy distribution. An r.f. resonance curve for a hyperfine transition was obtained by measuring the relative peak heights of the fluoresence spectrum for the two states as function of the frequency of the applied r.f. resonance curve for 'hot' atoms (after initial loading of the trap) were much wider than that of 'cool' atoms after application of longitudinal Doppler cooling. The author found that Doppler cooling of the sample required a very weak standing wave laser beam to avoid excess heating of the transverse degree of freedom.

53637 (CENBG–88-24) **Observation of the X-rays emitted in slow collisions between Ne^{9+} and Ne^{10+} ions and solid surfaces.** Andriamonje, S.; Azaiez, F.; Chemin, J.F.; Scheurer, J.N.; Bliman, S.; Dousson, S.; Hitz, D.; Bachau, H.; Salin, A. Bordeaux-1 Univ., 33 - Gradignan (France). Centre d'Etudes Nucleaires. 1988. 2p. (CONF-880955–: International conference on the physics of multiply charged ions and international workshop on E.C.R. ion sources, Grenoble (France), 12-16 Sep 1988). Order Number DE90713786. Available from NTIS (US Sales Only), PC A02/MF A01.

X-ray emission in collisions of slow multicharged ions with metallic surfaces were studied for the development of an ECR source. The used projectiles are slow Neon ions, Ne^{9+} and Ne^{10+}. A very large number of electrons are captured by the projectile. Twe correlated electrons may decay simultaneously in the K and L shell with the emission of one photon with an energy equal to the summed energies of the two transitions.

53638 (CONF-890953–7) **Is YbAs a heavy Fermion system?.** Monnier, R.; Degiorgi, L.; Delley, B.; Koelling, D.D. Argonne National Lab., IL (USA). Aug 1989. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. From International conference on the physics of highly correlated electron systems; Santa Fe, NM (USA); 11-15 Sep 1989. Order Number DE90001446. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Using parameters extracted from a tight binding fit to an ab initio band structure, the specific heat anomaly observed in YbAs around 5 K is computed within the infinite U limit of the degenerate Anderson impurity model. Applying the renormalization procedure derived in variational treatments of the periodic Anderson model, a quasiparticle Fermi surface with strong nesting features and small mass enhancements is obtained. The results suggest that YbAs is not a "classical" heavy Fermion system. 28 refs., 3 figs., 1 tab.

53639 (DOE/ER/13192–28) **Electron collisions with positive ions: Progress report, April 1, 1987–March 31, 1990.** Henry, R.J. Louisiana State Univ., Baton Rouge, LA (USA). Dept. of Physics and Astronomy. Sep 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-84ER13192. Order Number DE90001232. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

This report concerns a program of computation of cross sections for electron impact excitation and ionization of ions. 17 refs.

53640 (DOE/ER/13332–T2) **Spectroscopic studies of hydrogen atom and molecule collisions: Progress report.** Kielkopf, J. Louisville Univ., KY (USA). Sep 1989. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-85ER13332. Order Number DE90001221. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Atomic line profiles, molecular line intensities, continua from radiative dissociation, and radiation during close collisions, are phenomena that can be used to study atomic and molecular interactions. Recent progress with experiments and calculations for the case of atomic and molecular hydrogen is discussed here. 4 refs.

53641 (IEIE–8802, pp. 3) **Current status and future aspect of nitrogen plasma.** Ikuta, Nobuteru (Univ. of Tokushima (Japan)). Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related to electricity and information.* Available from NTIS (US Sales Only), PC A02/MF A01.

Nitrogen plasma is filled with active species which have high internal energy, and creates a very active state. The outline of the active species in nitrogen plasma is reviewed, and methods of their application are studied. The N_2 molecule has the highest dissociation energy among the diatomic molecules, and many of the excited atoms have long lives. The N_2 molecule has various long-life stable excitation levels. $A_3\epsilon u?$ particularly has conditions for easy gaining in the population, and plays the leading role. Brief explanation is made on the vibrational excitation level, and molecular and atomic ions. Nitrogen gas produces plasma with high resistivity which includes active species having potential (internal) energy in various levels, and nitrogen mixed gases are used in various systems where plasma is applied. As regards applications and future aspect of nitrogen plasma, summarized reports on laser, ozonizer, synthesis of ammonia, nitride ceramic, cermet, and processing of semiconductor elements are made. 10 references, 1 figure, 2 tables.

53642 (IEIE–8802, pp. 4) **Electrolytic dissociation process in nitrogen and produced species.** Ito, Haruo (Chiba Institute of Technology (Japan)). Institute of Electrical and Information Engineers (Japan). 5 Sep 1988. (In Japanese). (CONF-8810337–Pt.2: Joint convention record of institutes of electrical and information engineers, Niigata (Japan), 3-5 Oct 1988). In *Papers on lectures for joint conference of societies related to electricity and information.* Available from NTIS (US Sales Only), PC A02/MF A01.

Out of the active species comprising active nitrogen, metastable excitation molecule $A^3\Sigma u?$ and dissociated atom N are explained about the reaction (loss) and relaxation processes. Study on the data obtained so far, laying stress on metastable excitation process of $A^3\Sigma u?$, showed an extremely wide variation. It was because of the variance in effective levels depending on measurement conditions. The measured values of the radiation lives of $A^3\Sigma u?$ were 1-30 seconds except for a group. The large values of 10-30 seconds for the group seems possibly to be the values including cascade effect by the recombination of N atoms. The values of approximately 150 +1-20 (cm^2 s^{-1}) have been reported for the measurements of diffusion coefficients. The values of quenching rate coefficients with O_2 and N_2 are shown. One of the factors for maintaining the activity of nitrogen processing is the N atoms produced by dissociation. 84 references, 3 figures, 3 tables.

53643 (INIS-mf–12006, pp. 83) **Unexpected energy distribution of δ-electrons in collisions of I^{13+} ions with rare gases.** Kelbch, C. (Frankfurt Univ. (Germany, F.R.). Inst. fuer Kernphysik); Kelbch, S.; Schmidt-Boecking, H. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

We have measured doubly differential cross sections in 168 MeV I^{13+} on rare gas collisions in coincidence with the outgoing charge state of the projectile. The comparison of the spectra shows an increase of the mean emission energy with the degree of projectile charge exchange. (orig.).

53644 (INIS-mf–12006, pp. 145-153) **Molecular collision processes in the gas phase.** Arnold, F.; Fabian, R.; Hoffmann, J.; Knop, G.; Krieger, A.; Metzinger, P.; Moehler, O.; Mueckler, P.; Pfeilsticker, K.; Preissler, B. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number

DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Physical and chemical processes in ionized low temperature molecular gases (interstellar clouds, planetary atmospheres) are investigated. In particular ion-neutral interactions (ion-molecule reactions, ion-catalyzed gas phase reactions, ion-induced nucleation) are studied. Natural ions and neutral trace constituents of the Earth's atmosphere are analyzed, the latter using chemical ionization mass spectrometry. (orig.).

53645 (INIS-SU–122/A, pp. 391-392) **Investigation of ideality degree of hafnium dioxide monocrystals.** Voronov, V.V. (AN SSSR, Moscow (USSR). Inst. Obshchej Fiziki); Ivanov, A.V.; Markov, N.I.; Osiko, V.V.; Tatarintsev, V.M. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy, Moscow (USSR); Moscow (USSR), 14 Nov 1988; 14 nov 1988; CONF-8811252–). In *Crystal growth from melts. V. 3. Extended theses.* Order Number DE90705926. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

T-14397.

Short note. 2 refs.; 2 figs. HAFNIUM OXIDES/crystal structure; HAFNIUM OXIDES/solid solutions; YTTRIUM OXIDES/crystal structure; YTTRIUM OXIDES/solid solutions; CHEMICAL COMPOSITION; LATTICE PARAMETERS; MONOCRYSTALS

53646 (IPNO-DRE–89-06) **Excitation of giant resonances in heavy ion reactions at intermediate energies.** Suomijaervi, T.; Beaumel, D.; Blumenfeld, Y.; Chomaz, P.; Frascaria, N.; Garron, J.P.; Roynette, J.C.; Scarpaci, J.A.; Barrette, J.; Fernandez, B. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1989. 14p. Order Number DE90713758. Available from NTIS (US Sales Only), PC A03/MF A01.

Giant resonances in ^{90}Zr and ^{208}Pb have been studied by inelastic scattering of heavy ions using the SPEG spectrometer at Ganil. Intermediate energy heavy ions are compared to light ions as a probe to study giant resonances and the high cross sections and peak-to-background ratios obtained with heavy projectiles are stressed. It is shown that also in the case of heavy ions an accurate multipole analysis can be performed when a high resolution spectrometer is used. The influence of the Coulomb interaction on the excitation of the resonances is discussed.

53647 (IPNO-DRE–89-07) **Spin-flip transitions in ^{46}Ti, ^{48}Ti and ^{50}Cr excited by inelastic proton scattering.** Willis, A.; Morlet, M.; Marty, N.; Djalali, C.; Bohle, D.; Richter, A.; Stein, H. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1989. 25p. Order Number DE90713759. Available from NTIS (US Sales Only), PC A03/MF A01.

Forward angle cross sections for 1^+ states have been measured in the non closed shell nuclei ^{46}Ti, ^{48}Ti, ^{50}Cr by 201 MeV proton inelastic scattering. The total measured 1^+ strength is compared with microscopic distorted wave impulse approximation calculations using large scale shell model wave functions. The quenching for the 1^+ strength ranges from 0.3 to 0.5. For the low energy isovector 1^+ states the ratio of the orbital to the spin excitation is extracted.

53648 (ISN–88-73) **Quasi fusion of $^{139}La + {}^{12}C$ at intermediate energies. A study within the Landau Vlasov approach.** Suraud, E.; Schuck, P.; Pi, M. Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires. Jul 1988. 57p. Order Number DE90713761. Available from NTIS (US Sales Only), PC A04/MF A01.

An extensive study of the La + C reaction at 50 MeV/u is presented. A quasi fusion residue is found for any but very peripheral impact parameters, in agreement with recent experimental results. The same reaction is studied at higher energies and an approximate lower threshold for fusion is given. More symmetric systems are calculated showing a somewhat different behaviour.

53649 (ISN–88-75) **Semiclassical and phase space approaches to dynamic and collisional problems of nuclei.** Hasse, R.W.; Gregoire, C.; Remaud, B.; Jaenicke, J.; Schuck, P. Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires. Sep 1988. 49p. Order Number DE90713760. Available from NTIS (US Sales Only), PC A03/MF A01.

This article summarises recent work on the semiclassical (Thomas-Fermi like) treatment of nuclear correlations and dynamical problems. After a short outline of hte general technique the nucleon-nucleus optical potential in the doorway approximation (2p-1h and 2h-1p intermediate states) is treated. The imaginary part serves to calculate the energy dependent correction to the real part. The level density parameter, occupation numbers, and the mean free path are discussed. The semiclassical treatment of the nuclear response function is given in detail. Applications to inelastic electron scattering in the quasi-elastic peak region are presented. Analogously, inelastic proton scattering is calculated. Because of the surface absorption this reaction excites the surface response. The imaginary part of the single-particle (hole) potential in the evaluation of the response function introduces a 2p-2h spreading. The missing charge in the longitudinal response is reduced but not all experimental puzzles can be explained. The experience gained in the description of phenomena close to equilibrium serves to construct solutions of the Landau-Vlasov (alias Vlasov-Uehling-Uhlenbeck) equation for the description of non-equilibrium processes encountered in heavy ion reactions.

53650 (LBL–27553) **Multiple electron capture in close ion-atom collisions.** Schlachter, A.S.; Stearns, J.W.; Berkner, K.H.; Bernstein, E.M.; Clark, M.W.; DuBois, R.D.; Graham, W.G.; Morgan, T.J.; Mueller, D.W.; Stockli, M.P.; Tanis, J.A.; Woodland, W.T. Lawrence Berkeley Lab., CA (USA). 24 Jul 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098;AC06-76RL01830. (CONF-890708–9: 16. international conference on the physics of electronic and atomic collisions, New York, NY (USA), 26 Jul - 1 aug 1989). Order Number DE90001541. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Collisions in which a fast highly charged ion passes within the orbit of K electron of a target gas atom are selected by emission of a K x-ray from the projectile or target. Measurement of the projectile charge state after the collision, in coincidence with the K x-ray, allows measurement of the charge-transfer probability during these close collisions. When the projectile velocity is approximately the same as that of target electrons, a large number of electrons can be transferred to the projectile in a single collision. The electron-capture probability is found to be a linear function of the number of vacancies in the projectile L shell for 47-MeV calcium ions in an Ar target. 18 refs., 9 figs.

53651 (N–89-25104) **Charge exchange transition probability for collisions between unlike ions and atoms within the adiabatic approximation.** Xu, Y.J.; Khandelwal, G.S.; Wilson, J.W. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. Apr 1989. 43p. (NASA-TM–101559;NAS–1.15:101559). Available from NTIS, PC A03/MF A01.

A simple formula for the transition probability for electron exchange between unlike ions and atoms is established within the adiabatic approximation by employing the Linear Combination of Atomic Orbitals (LCAO) method. The formula also involves an adiabatic parameter, introduced by Massey, and thus the difficulties arising from the internal energy defect and the adiabatic approximation are avoided. Specific reactions Li(+++) + H to Li(++) + H(+) and Be(4+) + H to Be(3+) + H(+) are considered as examples. The calculated capture cross section results of the present work are compared with the experimental data and with the calculation of other authors over the velocity range of 10(7) cm/sec to 10(8) cm/sec.

53652 (SAND–89-2155C) **Stochastic electron beams in the ion-focussed regime.** O'Brien, K.J. Sandia National Labs., Albuquerque, NM (USA). [1989]. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8909216–1: DARPA/SDIO service annual charged particle beam review, Monterey, CA (USA), 18-21 Sep 1989). Order Number DE90000807. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In this paper we have studied the stochasticity of the triple-channel configuration. Further studies on the evolution of the ion-hose instability are under way but incomplete at present. 3 refs., 6 figs.

53653 (UCRL–101905) **Path integral simulations of liquid helium.** Pollock, R. Lawrence Livermore National Lab., CA (USA). Aug 1989. 21p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8908106–4: Los Alamos workshop on quantum simulations of condensed matter phenomena, Los Alamos, NM (USA), 8-11 Aug 1989). Order Number DE90001171. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Monte Carlo path integral methods have now been used to reproduce most of the non-dynamic properties of normal and superfluid helium in two and three dimensions in good agreement with experiment. Most of these properties can be related to simple geometric aspects of the paths. The superfluid transition in two and three dimensions will be emphasized. 22 refs., 7 figs.

53654 **Characterization of Al and Al-Cr-Al thin films.** DeLima, O.F. (Argonne Nat. Labs., Argonne, IL); Lepetre, Y.; Brodsky, M.B. pp. 811 of Interfaces, superlattices, and thin films. Dow, J.D.; Schuller, I.K Materials Research Society, Pittsburgh, PA (1987). (CONF-8612131–: Materials Research Society symposium on interfaces, superlattices and thin films, Boston, MA (USA), 1-6 Dec 1986).

TEM, X-ray diffraction, and electrical resistivity measurements were used to study the microstructure and the growth of Al-Cr-Al film sandwiches, where the individual Al layers were 300 A thick and the Cr thickness was varied between 0 - 10 atomic layers. The base vacuum was around 1.0 X 10^{-10} torr, substrate temperatures varied between 100 - 350°C, and evaporation rates were 3 A/s for Al and –0.1 - 0.2 A/s for Cr. All Al films had a strong (111) texture and showed a non-percolative island structure at 350°C. The films became connected at lower substrate temperatures, reaching perfect continuity at 100°C. However, electrical conductivity is achieved also for the films deposited at 350°C when one or more atomic layers of Cr are sandwiched between the Al layers. Results for the superconducting critical temperature and resistivity are discussed in terms of Cr diffusion into Al and the film size effect.

53655 **Exchange of bonded hydrogen in amorphous silicon by deuterium.** Abeles, B. (Brookhaven Nat. Lab., Upton, NY); Yang, L.; Leta, D.P.; Majkrazak, C. pp. 811 of Interfaces, superlattices, and thin films. Dow, J.D.; Schuller, I.K Materials Research Society, Pittsburgh, PA (1987). (CONF-8612131–: Materials Research Society symposium on interfaces, superlattices and thin films, Boston, MA (USA), 1-6 Dec 1986).

The authors show that bonded hydrogen in a-Si:H is readily exchanged by atomic deuterium when exposed to a deuterium plasma discharge. The effective diffusion coefficient for the D, H exchange, 10^{-14} cm^2/sec at 160°C, is comparable to that of interstitial hydrogen in c-Si.

53656 **Observation of a speed-dependent collisional inhomogeneity in H_2 vibrational line profiles.** Farrow, R.L. (Combustion Research Facility, Sandia National Laboratories, Livermore, California 94551-0969 (US)); Rahn, L.A.; Sitz, G.O.; Rosasco, G.J. *Physical Review Letters (USA)*, 63(7): 746-749 (14 Aug 1989).

We report observations of inhomogeneous broadening in the vibrational line profiles of a gas in the "impact" density regime. In measurements up to 27 amagat (where the spectra are dominated by collision broadening), non-Lorentzian, asymmetric features are observed in Raman *Q*-branch transitions of H_2 dilute in a heavy perturber gas. We compare these measurements with an inhomogeneous line-profile model based on collisional shifts that strongly depend on the (thermal) speed of the H_2 radiator. Quantitative agreement is obtained only when speed-changing collisions are considered, which result in spectral line narrowing.

6404 Fluid Physics

Refer also to citation(s) 52424

53657 (AD-A–209469/6/XAB) **Laboratory plasma studies. Final report.** Hyman, E.; Bacon, D.; Boris, P.; Deniz, A. Science Applications International Corp., McLean, VA (USA). 23 May 1989. 1069p. Available from NTIS, PC A99/MF E06.

FREE ELECTRON LASERS; PINCH EFFECT; ELECTRON BEAMS; SOLAR CORONA; MAGNETOHYDRODYNAMICS; LINEAR Z PINCH DEVICES; MICROWAVE AMPLIFIERS; CYCLOTRON RESONANCE; MASERS; KLYSTRONS; ENERGY TRANSFER; MAGNETOHYDRODYNAMICS; RELATIVITY THEORY; KRYPTON FLUORIDE LASERS; LARMOR RADIUS; PROGRESS REPORT

53658 (DOE/ER/13839–2) **Comparative study of the vorticity field in turbulent flows: Theory, experiments and computations: Second year progress report.** Hussain, F. Houston Univ., TX (USA). Dept. of Mechanical Engineering. 10 Oct 1989. 20p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-88ER13839. Order Number DE90001399. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The main thrust of our research has been to apply the coherent structures approach to understand, analyze and model turbulent flows. We consider vorticity as the defining property of coherent structures. Turbulent flows are characterized by vortical structures undergoing deformation and interaction due to self- and mutual inductions. One of the primary objectives of our research is to obtain a detailed understanding of these interactions. The concepts of vortex dynamics, when applied to coherent structures, have helped us to understand many of the peculiarities of the noncircular jets, especially elliptic jets. The structures in these jets have nonplanar advections, thus having the simplicity allowing their evolution yet retaining the 3-D features generic of all coherent structures in turbulent shear flows. 16 refs., 6 figs.

53659 (ENEA-RT-FUS–88-27) **Modification of MHD activity by lower hybrid current drive.** Romanelli, F.; Cardinali, A.; Bartiromo, R. ENEA, Frascati (Italy). Centro Ricerche Energia. May 1989. 13p. Order Number DE89793066. Available from NTIS (US Sales Only), PC A03/MF A01.

Submitted to Physics of Fluids.

The effect of magnetic islands on the propagation of lower hybrid waves is analytically investigated for a model slab equilibrium with a single helicity perturbation corresponding to a m=1 or m=2 island. From the variation of k parallel inside the island, the parallel current is estimated with the same pitch of the original perturbation. The effect of such a current on the nonlinear evolution of an m=2 island corresponds to a destabilization of the mode if the RF-driven current is in the same direction of the global parallel current. A comparison with numerical solutions of the problem, by the use of a toroidal ray trajectory code, is also presented.

53660 (UCRL–101907) **Irreversible processes from reversible mechanics.** Hoover, W.G.; Hoover, C.G.; Evans, W.J.; Moran, B.; Levatin, J.A.; Craig, E.A. Lawrence Livermore National Lab., CA (USA). Aug 1989. 76p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8908158–1: Conference on microscopic simulation of complex flows, Brussels (Belgium), 21-25 Aug 1989). Order Number DE90001057. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

We describe and illustrate methods for treating many-body irreversible processes using time-reversible deterministic Nose-Hoover thermostats. In phase space, Lyapunov-unstable multifractal strange attractors are the common feature representing any of these nonequilibrium flows, be they steady, periodic, or transient. This generic behavior is illustrated here for three prototypical one-body problems: steady field-driven diffusive flow in a Galton Board, time-periodic boundary-driven viscous flow of a Lorentz gas, and transient, but time-periodic, compressible flow characterizing a one-dimensional free expansion followed by compression and thermalization. 20 refs., 25 figs.

53661 (UCRL–101976) **Sub-structuring lattice gases.** Elton, B.; Rodrigue, G. Lawrence Livermore National Lab., CA (USA). 1989. 14p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8903169–1: 3. international symposium on domain decomposition, Houston, TX (USA), 20-22 Mar 1989). Order Number DE90001146. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In this paper we apply domain decomposition techniques to lattice gases. We demonstrate how a lattice gas can be modeled by a non- linear partial differential equation using the same classical techniques as were used by Chapman and Enskog in approximating the kinetics of a real gas. As an example, we show how a

1-dimensional viscous Burgers' equation models a specific lattice gas. We then use the domain decomposition ideas for solving this differential equation to develop a sub-structuring technique for this exemplary lattice gas. 5 refs., 5 figs.

53662 **Accurate semi-implicit treatment of the Hall effect in magnetohydrodynamic computations.** Harned, D.S. (Science Applications International Corporation, 10260 Campus Point Drive, San Diego, CA 92121 (US)); Mikic, Z. *Journal of Computational Physics (USA),* 83(1): 1-15 (Jul 1989).

A semi-implicit operator is derived for the Hall term that, when implemented in the MHD equations, allows time steps comparable to those normally used in semi-implicit MHD computations. The operator is fourth order in the direction of the magnetic field and is most accurate when used in a split time step algorithm. The effects of the semi-implicit treatment on linear waves in a cylinder are shown both through a detailed analysis and numerical tests. The effectiveness of the algorithm is also demonstrated with a nonlinear computation of a tokamak tearing instability. © 1989 Academic Press, Inc.

53663 **Semi-implicit reduced magnetohydrodynamics.** Kress, M.E. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012 (US)); Riedel, K.S. *Journal of Computational Physics (USA),* 83(1): 237-239 (Jul 1989).

A modification of the predictor correlator algorithm is applied to the reduced MHD equations. (AIP)

53664 **Method for measuring the stochastic properties of corona and partial-discharge pulses.** Van Brunt, R.J. (National Institute of Standards and Technology, Gaithersburg, Maryland 20899 (US)); Kulkarni, S.V. *Review of Scientific Instruments (USA),* 60(9): 3012-3023 (Sep 1989).

A new method is described for measuring the stochastic behavior of corona and partial-discharge pulses which utilizes a pulse selection and sorting circuit in conjunction with a computer-controlled multichannel analyzer to directly measure various conditional and unconditional pulse-height and pulse-time-separation distributions. From these measured distributions it is possible to determine the degree of correlation between successive discharge pulses. Examples are given of results obtained from measurements on negative, point-to-plane (Trichel-type) corona pulses in a N_2/O_2 gas mixture which clearly demonstrate that the phenomenon is inherently stochastic in the sense that development of a discharge pulse is significantly affected by the amplitude of and time separation from the preceding pulse. It is found, for example, that corona discharge pulse amplitude and time separation from an earlier pulse are not independent random variables. Discussions are given about the limitations of the method, sources of error, and data analysis procedures required to determine self-consistency of the various measured distributions.

53665 **Nonlinear saturation of ballooning modes in tokamaks and stellarators.** Bauer, F. (New York Univ., NY (USA)); Garabedian, P.; Betancourt, O. *Proceedings of the National Academy of Sciences of the United States of America (USA),* 85(20): 7423-7425 (Oct 1988). DOE Contract FG02-86ER53223.

The spectral code BETAS computes plasma equilibrium in a toroidal magnetic field $B = \nabla s \times \nabla \psi$ with remarkable accuracy because the finite difference scheme employed in the radial direction allows for discontinuities of the flux function ψ across the nested surfaces s = const. Instability of higher modes in stellarators like the Heliotron E can be detected in roughly an hour on the best supercomputers by calculating bifurcated equilibria that are defined over just one field period. The method has been validated by comparing results about nonlinear saturation of ballooning modes in tokamaks with numerical data from the PEST code.

53666 **Statistical effects in the absorption and optical activity of particulate suspensions.** Bustamante, C. (Univ. of New Mexico, Albuquerque (USA)); Maestre, M.R. *Proceedings of the National Academy of Sciences of the United States of America (USA),* 85(22): 8482-8486 (Nov 1988). DOE Contract AC03-76SF00098.

The phenomenon of Duysens flattening of the absorption spectra resulting from the inhomogeneous distribution of the chromophores in the solution is analyzed. These inhomogeneities are treated as localized statistical fluctuations in the concentration of the absorbing species, by using the Gaussian distribution. A law of absorbance is obtained, and the effect of light scattering on the flattening is also characterized. The flattening in the circular dichroism spectra of particulate suspensions is then analyzed. It is shown that the degree of flattening of the circular dichroism of a suspension is, in general, different from the corresponding flattening of its absorption spectrum. A quantitative relationship between the two effects is established.

6450 High Energy Physics

Refer also to citation(s) 52971, 53973

53667 (DOE/ER/01112–1989) **Studies of elementary particles: Progress report and proposal.** Michigan Univ., Ann Arbor, MI (USA). Dept. of Physics. 16 May 1989. 90p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76ER01112. Order Number DE90001120. Available from NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.

This report discusses the following tasks: Task B has completed and successfully operated 8 Michigan muon array patches for the UMC experiment. Data from the detector has already improved the limits on the ratio of gamma rays to hadrons in primary cosmic rays. The Task C built luminosity monitor for the Mark II detector is functioning well and fulfilling its key role in the determination of the Z mass and width. Major Task C contributions to the machine diagnostics, the beamstrahlung monitor and wire scanner, have provided critical tuning information for the SLC. Task E has recently reported the detection of 200 GeV γ-rays from the Crab Nebula with a statistical significance of 5.8 σ. This observation confirms the importance of imaging techniques for VHE γ-ray astronomy. The Michigan theory group (Task G) has focused on: Working to understand the systematics of gluon dynamics in poorly understood pseudoscalar meson decays; Exploring the consequences of heavy Higgs boson and/or a top quark more massive than the W^{+-} or Z; Surveying the potentially attractive ways of experimentally searching for the Higgs boson of the minimal Standard Model or the spectrum of Higgs bosons to be expected in extensions of the Standard Model; Calculating the radiative corrections for $W^+W^- \rightarrow W^+W^-$ as a precision test of the Standard Model, especially in its sensitivity to the Higgs sector; Investigating the modifications of general relativity arising from quantum fluctuations of matter; Exploring phenomenological test of CP violation dynamics; Developing relations between the strong CP problem and ElectroWeak CP violation; and Investigating 4-Fermi interactions in Technicolor models.

53668 (DOE/ER/02504–475) **High energy accelerator and colliding beam user group: Progress report, March 1, 1989–February 28, 1990.** Maryland Univ., College Park, MD (USA). Dept. of Physics and Astronomy. Sep 1989. 120p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-76ER02504. Order Number DE90001398. Available from NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.

This report discusses the following topics: OPAL experiment at LEP; Deep inelastic muon interactions at TeV II; Dϕ experiment; Physics with the CLEO detector at CESR; CYGNUS experiment; ν_ee elastic scattering experiment; Further results from JADE; Theory of polarization in electron storage rings; and Rare kaon decay experiments at Brookhaven National Laboratory.

53669 (DOE/FTR–90001701) **[Third workshop on high energy spin physics]: Foreign trip report, September 4, 1989–September 15, 1989.** Ratner, L.G. Brookhaven National Lab., Upton, NY (USA). 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. Order Number DE90001701. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The spin physics workshop presented information on the present status of experiments and outlined an ambitious program to be accomplished in the first five years of UNK operation at fixed target energies of 400 GeV and 3 TeV. In addition, details were given on the status of UNK, including possible collaboration with CERN for a $\bar{p}p$ 3 TeV x 3 TeV collider, and on VLEPP, a 1 TeV x 1 TeV linear electron collider. All of these seem to have the solid commitment of the Soviet Union. Discussions were also held at Dubna on the superferric magnet accelerator under construction, the polarized D_2

source, and the plans of various experimenters to propose D_2 experiments at the AGS.

6451 Particle Interactions and Properties - Experimental

Refer also to citation(s) 52546, 53771

53670 (BNL–43263) **Current status of E/f_1(1420) and ι/η(1450).** Chung, S.U. Brookhaven National Lab., Upton, NY (USA). Sep 1989. 29p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8906194–2: International meeting on physics at KAON, Bad Honnef (Germany, F.R.), 7-9 Jun 1989). Order Number DE90001265. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The current status and future prospects are given of the E/f_1(1420) and the η(1430) region containing the ι/η(1450). These states are seen in the channels $K\bar{K}\pi$ and $\eta\pi\pi$. 43 refs., 10 figs., 5 tabs.

53671 (DOE/ER/13065–586) **A combined analysis of SLAC [Stanford Linear Accelerator Center] experiments on deep inelastic e-p and e-d scattering.** Whitlow, L.W.; Bodek, A.; deBarbaro, P.; Dasu, S.; Harada, H.; Krasny, M.W.; Lang, K.; Riordan, E.M.; Rock, S.; Arnold, R.; Benton, D.; Bosted, P.; Button-Shafer, J.; deChambrier, G.; Clogher, L.; Lung, A.; Szalata, Z.M.; Filippone, B.; Jourdan, J.; MilnerRochester Univ., NY (USA). Dept. of Physics and Astronomy. 21 Aug 1989. 19p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76ER13065. (UR–1119;CONF-890903–1: International Europhysics conference on high-energy physics, Madrid (Spain), 7-14 Sep 1989). Order Number DE90001134. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

We report recent work on the extraction of $R = \sigma_L/\sigma_T$ and the structure function F_2 over a large kinematic range, which is based on a reanalysis of deep inelastic e-p and e-d scattering cross sections measured at SLAC between 1970 and 1985. All these data were corrected for radiative effects using improved versions of external and internal radiative correction procedures. The data from seven individual experiments were normalized to those from the recent high-precision SLAC experiment E140. We find that $R_p = R_d$, as expected in QCD. The value of R is higher than predicted by QCD even when target-mass effects are included. This difference indicates that additional dynamical higher-twist effects may be present. The structure functions F_2p and F_2d were also extracted from the full data sets of normalized cross sections using an empirical fit to R. These structure functions were then compared with data from the CERN muon scattering experiments BCDMS and EMC. We find that our data are consistent with the EMC data, if the latter are multiplied by a normalization factor of 1.07. No single, uniform normalization factor can be applied to the BCDMS data that will bring them into agreement with SLAC data in the region of overlap. 17 refs., 4 figs.

53672 (DOE/ER/13065–592) **Production of hybrid mesons in the nuclear Coulomb field.** Ferbel, T. Rochester Univ., NY (USA). Dept. of Physics and Astronomy. 9 Oct 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76ER13065. (UR–1129;CONF-8909221–1: HADRON '89: 3rd international conference on hadron spectroscopy, Ajaccio (France), 23-27 Sep 1989). Order Number DE90001578. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

We provide the motivation and update on an experiment being planned at Fermilab to search for an isovector $J^{PC} = 1^{-+}$ meson via the Primakoff effect. 11 refs., 7 figs.

53673 (INIS-mf–12006, pp. 100-103) **Deep-inelastic myon-nucleus-scattering at the CERN SPS.** Alberich, T.; Bird, I.G.; Brueckner, W.; Dierberger, B.; Doebbeling, H.; Dueren, M.; Harrach, D. von; Kabuss, E.M.; Mizuno, Y.; Mueller, A. NMC Collaboration. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Our group is involved in deep inelastic muon nucleon and muon nucleus scattering experiments performed by the NMC collaboration at CERN. The analysis of the data taken in 1986-88 is in progress. Preliminary results for the ratios of the free nucleon structure functions F_2 for proton and neutron, extracted from about 25% of the present data sample, are in good agreement with those from previous muon experiments. Nuclear effects in structure functions have been investigated in 1986-87 with deuterium, helium, lithium, carbon and calcium targets. Below x=0.3 the data have statistical and systematic errors smaller than about one percent. They allow for the first time a detailed study of the EMC effect at small values of x. Preliminary results for $F_2(He)/F_2(D)$, $F_2(C)/F_2(Li)$ and $F_2(Ca)/F_2(Li)$ show that the structure function ratios of heavy to light nuclei are by a few percent bigger than one in the range $x_c<x<0.3$ and smaller than one for $x_c<x$. The value of x_c, where the ratio is equal to one, and of the magnitude of the effect increase with A. In 1988 about 100 million deep inelastic events for carbon and tin have been collected. For these measurements the trigger scheme has been optimized using a special target calorimeter system, which has been built at our institute. (orig.).

53674 (INIS-mf–12006, pp. 108-109) **Proposal for measuring the internal spin structure of proton and neutron.** Bird, I.; Brueckner, W.; Dueren, M.; Gaul, H.G.; Kabuss, E.; Martin, B.; Nowotny, D.; Povh, B.; Rith, K.; Scholz, C. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

We propose to measure the spin dependent structure functions $g_1(x)$ and $g_2(x)$ of proton and neutron using the longitudinally polarized electron beam of the HERA storage ring at DESY and an internal polarized hydrogen and deuterium gas target. (orig.).

53675 (LAPP-EXP–88-12) **Cryogenic detectors: status and prospects.** Gonzalez-Mestres, L.; Perret-Gallix, D. Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules. 1988. 7p. (CONF-880867–: 24. international Rochester conference on high energy physics, Munich (Germany, F.R.), 4-10 Aug 1988). Order Number DE90713782. Available from NTIS (US Sales Only), PC A02/MF A01.

The present status of cryogenic detector developments for particle physics is discussed, with emphasis on applications at the cross-disciplinary frontier between particle physics and astrophysics, where low temperature devices appear to be particularly well suited. The critical overview of to-date results is completed by a sketch of new ideas and possible ways for further improvements.

53676 (LAPP-EXP–88-19) **Neutrino oscillations at nuclear reactors.** Talby, M. Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules. 1988. 4p. (CONF-880867–: 24. international Rochester conference on high energy physics, Munich (Germany, F.R.), 4-10 Aug 1988). Order Number DE90713783. Available from NTIS (US Sales Only), PC A02/MF A01.

The status and the prospects of neutrino oscillation at nuclear reactors is reviewed. Neutrino oscillations are the best tool for probing neutrino mass and lepton number non-conservation. Five neutrino oscillation experiments have been carried out since 1981 but did not show any evidence for oscillations. New experiments are prepared by the Bugey group, the Moscow group and the Rovno group. New generations of detectors should play a role to fill the gap betwen present reactor limits and solar neutrino limits.

53677 (LA-UR–89-1304) **Lepton-pair production in hadron-nucleus collisions.** Moss, J.M.; Peng, J.C.; Alde, D.M.; Baer, H.W.; Carey, T.A.; Garvey, G.T.; Klein, A.; Lee, C.; Leitch, M.J.; Lillberg, J.W. Los Alamos National Lab., NM (USA). 1989. 20p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-891134–1: INS international symposium on nuclear physics at intermediate energy, Tokyo (Japan), 15-17 Nov 1989). Order Number DE89011175. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Physics motivations for precision measurements of lepton pair production in nuclei are discussed. Preliminary results from Fermilab Experiment E772 are presented. The relevance of these results to the EMC effect and to J/ψ suppression in heavy ion collisions is also discussed. 34 refs., 17 figs.

53678 (LBL–27723) **A search for the electric dipole of the electron.** Abdullah, K.F. Lawrence Berkeley Lab., CA (USA). Aug 1989. 111p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE90001572. Available from NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.

We report a new upper limit on the electric dipole moment (EDM) of the electron of $d_e = 0.1 \pm 3.2 \times 10^{-26}$ e-cm. This precision is one hundred times better than any previously published limit and a factor of two better than that of unofficial reports. Recently there has been a great deal of theoretical interest in the possibility of a non-zero electron EDM. Models such as the left-right-symmetric Standard Model and an "off-standard" model with new heavy neutrinos are constrained by the new limit on d_e. A non-zero electron EDM would violate the time reversal and parity space-time symmetries. T-violation was observed in neutral kaon decay and is still not fully explained by the Standard Model. Our experimental technique involves searching for an energy shift, linear in applied electric field, between the $m_F = 1$ and $m_F = -1$ magnetic sublevels of the F=1 hyperfine level of the $6^2P_{1/2}$ ground state of atomic thallium. If the electron has a non-zero EDM, this thallium state will exhibit an atomic electric dipole moment that is roughly 600 times larger. The energy shift is detected with the technique of magnetic resonance spectroscopy, employing separated oscillating fields, applied to an atomic beam of thallium. In the approach, any relative phase-shift between the $m_F = \pm 1$ components of the F=1 wavefunction acquired by the atom as it travels through an electric field is detected through interference with two separate oscillating magnetic fields located on either side of the electric field. The new level of precision is achieved through several improvements on previous experiments including employment of a vertical apparatus, two opposing atomic beams, and optical pumping for atomic state selection and analysis.

53679 (SLAC-PUB–5000) **CP violation in rare K decays.** Gilman, F.J. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Aug 1989. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8905219–1: Conference on CP violation in particle physics and astrophysics, Blois (France), 22-26 May 1989). Order Number DE90000946. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Recent theoretical and experimental progress on CP violation, particularly for rare K decays, is summarized. 36 refs., 6 figs.

53680 (SLAC-PUB–5061) **Status of the tau one prong problem.** Hayes, K.G. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Aug 1989. 18p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8905144–14: Tau-Charm workshop, Stanford, CA (USA), 23-27 May 1989). Order Number DE90000944. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The present status of the tau one prong problem is reviewed. Emphasis is placed on recent published branching fraction measurements, the status and implications of tau lifetime measurements, and measurements which constrain the sum of branching fractions to be unity. 29 refs., 10 figs., 2 tabs.

53681 (SLAC-PUB–5082) **Color transparency and the structure of the proton in quantum chromodynamics.** Brodsky, S.J. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jun 1989. 88p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8902139–1: Distinguished-speaker colloquium series, Minneapolis, MN (USA), 2 Feb 1989). Order Number DE90000940. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Many anomalies suggest that the proton itself is a much more complex object than suggested by simple non-relativistic quark models. Recent analyses of the proton distribution amplitude using QCD sum rules points to highly-nontrivial proton structure. Solutions to QCD in one-space and one-time dimension suggest that the momentum distributions of non-valence quarks in the hadrons have a non-trivial oscillatory structure. The data seems also to be suggesting that the "intrinsic" bound state structure of the proton has a non-negligible strange and charm quark content, in addition to the "extrinsic" sources of heavy quarks created in the collision itself. As we shall see in this lecture, the apparent discrepancies with experiment are not so much a failure of QCD, but rather symptoms of the complexity and richness of the theory. An important tool for analyzing this complexity is the light-cone Fock state representation of hadron wavefunctions, which provides a consistent but convenient framework for encoding the features of relativistic many-body systems in quantum field theory. 121 refs., 44 figs., 1 tab.

53682 (SLAC-PUB–5087) **Study of Ds decays.** Toki, W.H. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Sep 1989. 6p. Sponsored by U.S. DOE Energy Research; National Science Foundation. DOE Contract AC03-76SF00515;AC02-76ER01195;AC03-81ER40050;AC02- (CONF-8905220–1: KEK topical conference on e^+e_- collision physics, Tsukuba (Japan), 17-19 May 1989). Order Number DE90000939. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

In the spectator model, the lowest lying bound state of the charm-strange quarks, the Ds meson, is predicted to decay via W emission from the charm quark and form states with $s\bar{s}$ hidden strangeness. The conventional hadronic modes will contain $K\bar{K}$, ϕ and the $f_0(975)$, which is considered to be the $J^{PC} = 0^{++}$ isoscalar $s\bar{s}$ meson. Hadronic decays of the Ds meson have been measured in relatively few modes and all modes are measured relative to the $\phi\pi$ mode. In this paper, an upper limit for the absolute branching ratio of the Ds decay into the $\phi\pi$ mode and evidence for the decay, $Ds \rightarrow f_0(975)\pi$ is presented from the Mark III. 26 refs., 4 figs.

53683 (SLAC-PUB–5093) **Study of Ψ' decays.** Toki, W.H. Mark III Collaboration. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Sep 1989. 8p. Sponsored by U.S. DOE Energy Research; National Science Foundation. DOE Contract AC03-76SF00515;AC02-76ER01195;AC03-81ER40050;AC02-(CONF-8906204–5: International symposium on heavy quark physics, Ithaca, NY (USA), 13-17 Jun 1989). Order Number DE90000936. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Hadronic decays of the ψ' are reviewed and a new preliminary upper limit of $B(\psi \rightarrow \rho\pi) < 7.0 \times 10^{-5}$ at 90% C.L. from the Mark III is presented. 13 refs., 4 figs., 1 tab.

53684 (SLAC-PUB–5094) **Tau Charm Factory physics.** Toki, W.H. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Sep 1989. 12p. Sponsored by U.S. DOE Energy Research; National Science Foundation. DOE Contract AC03-76SF00515;AC02-76ER01195;AC02-87ER40318. (CONF-8906204–4: International symposium on heavy quark physics, Ithaca, NY (USA), 13-17 Jun 1989). Order Number DE90000935. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Tau Charm Factories proposed for future machines will provide powerful and unique facilities to study a variety of physics topics: the tau lepton, charm mesons, charmonium and the J/ψ decays. These topics cover the physics of the members of the first and second quark doublets and the third lepton doublet. A workshop held at Stanford Linear Accelerator Center reviewed the physics, the machine and the detector for such a facility. In this paper, highlights of this meeting will be reviewed. We will begin with a short sketch of the machine issues and then briefly describe topics in tau, charm and charmonium-J/ψ physics. 49 refs., 2 figs., 1 tab.

53685 **Measurement of the ratio of sea to valence quarks in the nucleon.** Heinrich, J.G. (Enrico Fermi Institute and Department of Physics, The University of Chicago, Chicago, Illinois 60637 (US)); Adolphsen, C.E.; Alexander, J.P.; Anderson, K.J.; Conway, J.S.; Pilcher, J.E.; Possoz, A.; Rosenberg, E.I.; Biino, C.; Greenhalgh, J *Physical Review Letters (USA)*, 63(4): 356-359 (24 Jul 1989). DOE Contract AC02-76ER03072;W-7405-ENG-82.

The ratio of sea to valence quarks for nucleons in tungsten has been measured for the fractional momentum range $0.04 < x_N < 0.36$. The determination is based on the relative production rate of muon pairs by π^+ and π^- beams on a tungsten target. The results provide the most accurate determination to date of this ratio in the region $x_N < 0.1$ and $Q^2 > 20$ GeV^2, and are in good agreement with earlier measurements.

53686 **Initial measurements of Z-boson resonance parameters in e^+e^- annihilation.** Abrams, G.S.; Adolphsen, C.E.; Aleksan, R.; Alexander, J.P.; Allen, M.A.; Atwood, W.B.; Averill, D.;

Ballam, J.; Bambade, P.; Barish, B.C.; and others. *Physical Review Letters (USA)*, 63(7): 724-727 (14 Aug 1989).

We have measured the mass of the Z boson to be 91.11±0.23 GeV/c^2, and its width to be $1.61_{-0.43}{}^{+0.60}$ GeV. If we constrain the visible width to its standard-model value, we find the partial width to invisible decay modes to be 0.62±0.23 GeV, corresponding to 3.8±1.4 neutrino species.

53687 Measurement of the mass and width of the Z^0 boson at the Fermilab Tevatron. Abe, F.; Amidei, D.; Apollinari, G.; Atac, M.; Auchincloss, P.; Baden, A.R.; Bamberger, A.; Barbaro-Galtieri, A.; Barnes, V.E.; Bedeschi, F.; and others. *Physical Review Letters (USA)*, 63(7): 720-723 (14 Aug 1989).

An analysis of $Z^0 \rightarrow e^+e^-$ and $Z^0 \rightarrow \mu^+\mu^-$ data from the Collider Detector at Fermilab in $\bar{p}p$ collisions at $\sqrt{s}$= $1.8 TeV yields a mass of the Z^0$ boson of M_Z=90.9±0.3 (stat+syst)±0.2 (scale) GeV/c^2 and a width of Γ_z=3.8±0.8±1.0 GeV.

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Refer also to citation(s) 53108, 53589, 53679, 53681, 53682, 53734, 53735

53688 (BNL–42381) **Kaon decays: An overview.** Marciano, W.J. Brookhaven National Lab., Upton, NY (USA). Jan 1989. 25p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8811125–6: Rare decay symposium, Vancouver (Canada), 30 Nov - 3 dec 1988). Order Number DE89009532. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A survey of rare and not so rare kaon decays is presented. The role of such decays both in testing the standard model and searching for "new physics" is discussed. 37 refs., 2 tabs.

53689 (BNL–43292) **A theoretical perspective on neutrino physics.** Marciano, W.J. Brookhaven National Lab., Upton, NY (USA). Sep 1989. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8905183–4: Workshop on physics at the main injector, Batavia, IL (USA), 16-18 May 1989). Order Number DE90000759. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

A survey of $\sin^2 \theta_W$, ρ, CKM matrix, and axial-isoscalar neutral current measurements via neutrino scattering is presented. Loop effects due to heavy top or a fourth generation are described. Neutrino oscillations are discussed in a three generation mixing framework and some motivation for $\nu_\mu \rightarrow \nu_\tau$ oscillation searches is given. 15 refs., 1 tab.

53690 (CNIC–00211) **Consideration of BRST cohomology in the first quantization of RNS string.** Hu Hongliang; Wang Rong and others. China Nuclear Information Centre, Beijing, BJ (China). May 1988. 6p. Order Number DE90603518. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The differen of Grassmanian even-odd degree even-odd of (super-) conformal ghosts is stressed. With some modifications in the BRST charges and the commutation relations, it can be shown that the first quantization of RNS strings allows the BRST cohomology analysis.

53691 (CNIC–00212) **Gluon condensate contributions in the $\Delta I = 1/2$ rule.** Huang Zheng; Huang Tao. China Nuclear Information Centre, Beijing, BJ (China). Aug 1988. 9p. Order Number DE90603519. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The vacuum background fields method is used to correct the coefficient functions of the 0_+ and 0_- operators in $\Delta S = 1$ effective weak Hamiltonian responsible for K->2π decays. The additional relative octet enhancement factor of 2~3 is obtained by accounting for the gluon condensate correntions if the scale parameter μ^2 is set below 1 GeV^2.

53692 (CNIC–00217) **Charmed meson nonleptonic decays and SU(3) symmetry.** Chen Fengzhi; Wang Ping. China Nuclear Information Centre, Beijing, BJ (China). Jun 1988. 8p. Order Number DE90603520. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Based on the analysis of SU(3) symmetry property, it is pointed that the Cabbibo favored nonleptonic decays of charmed mesons should be treated in two different case: (i) octet-octet final states and (ii) octet-singlet final states. In case (i) the spectator process gives correct predictions, but in case (ii) the decay mechanism is different. A theoretical lower limit of $Br(D_s^+ \rightarrow \omega\pi^+)$ is given which cannot go through spectator process. This channel, as well as $D_s^+ \rightarrow \omega e^+ \nu$ are recommended to search for in experiments.

53693 (CNIC–00219) **Non-leptonic decay of T-mesons.** Chen Fengzhi. China Nuclear Information Centre, Beijing, BJ (China). Jun 1988. 10p. Order Number DE90603521. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Using SU(3) symmetry of u-,d- and s-quarks, the author calculated the decay amplitudes of T-mesons non-leptonic decay and expressed the results in terms of reduced matrix elements.

53694 (DOE/ER/40283–8) **New computational methods for determining antikaon-nucleus bound states.** Fink, P.J. Jr. Oregon State Univ., Corvallis, OR (USA). 24 May 1989. 403p. Sponsored by U.S. DOE Energy Research. DOE Contract FG06-86ER40283. Order Number DE90001695. Available from NTIS, PC A18/MF A01; OSTI; INIS; GPO Dep.

Optical potential for antikaon-nucleus strong interactions are constructed using elementary antikaon-nucleus potentials determined previously. The optical potentials are used to determine the existence of a kaon hypernucleus. Modern three dimensional visualization techniques are used to study model dependences, new methods for speeding the calculation of the optical potential are developed, and previous approximation to avoid full Fermi averaging are eliminated. 19 refs., 21 figs., 3 tabs.

53695 (HD-PY–89/03) **Neutron decay, semileptonic hyperon decay and the Cabibbo model.** Siebert, H.W. Heidelberg Univ. (Germany, F.R.). Physikalisches Inst. 1989. 12p. (CONF-8903138–: ILL workshop on fundamental physics with slow neutrons, Grenoble (France), 8-11 Mar 1989). Order Number DE90711366. Available from NTIS (US Sales Only), PC A03/MF A01.

The decay rates and formfactor ratios of neutron decay and semileptonic hyperon decays are compared in the framework of the Cabibbo model. The results indicate SU(3) symmetry breaking. The Kobayashi-Maskawa matrix element V_{us} determined from these decays is in good agreement with the value determined from K->$\pi e \nu$ decays, and with unitarity of the KM-matrix. (orig.).

53696 (HD-THEP–88-19) **Baryonic sum rules and factorization of four-quark operators.** Jamin, M. Heidelberg Univ. (Germany, F.R.). Inst. fuer Theoretische Physik; Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet. Jun 1988. 81p. (In German). Available from Heidelberg Univ. (Germany, F.R.). Inst. fuer Theoretische Physik.

The radiative corrections up to first order in the strong coupling constant for the two-point functions of nucleon and delta are newly calculated. The factorization of the four-quark operators is performed renormalization-group invariantly and from the obtained sum rules the value of the quark condensate is determined. (orig.).

53697 (IFVE-ONF/OTF–88-203) **Problems of superstring-inspired models with right-handed gauge symmetry.** Kereselidze, A.R.; Liparteliani, A.G.; Volkov, G.G. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1988. 17p. Order Number DE90603581. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to the journal Intern. J. Mod. Phys. A.

In the present paper the viability of E6 and SO(10) - based superstring inspired models whose gauge symmetry includes $SU(2)_R$ or $U(1)_{T3R}$ factors is considered. The analysis is performed with account for the neutrino mass and proton decay problems as well as for low-energy values of weinberg angle and other phenomenological consequences. 16 refs.; 7 tabs.

53698 (INIS-mf–12006, pp. 115) **s-wave nucleon-antinucleon interaction in the constituent quark model.** Ihle, G. (Heidelberg

Univ. (Germany, F.R.). Inst. fuer Theoretische Physik); Pirner, H.R.; Richard, J.M. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

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53699 (INIS-mf–12006, pp. 115) **Coupled-channel effective-range expansion of low energy Nanti N scattering.** Mahalanabis, J. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.)); Pirner, H.J.; Shibata, T.A. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

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53700 (INIS-mf–12006, pp. 115) **Nanti N-annihilation in the large N_c-limit.** Pirner, H.J. (Heidelberg Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

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53701 (INIS-mf–12006, pp. 116) **Hadron production in e^+e^- annihilation and μ-p collisions under the assumption of longitudinal phase space dominance.** Kurihara, Y.; Huefner, J.; Aichelin, J. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Published in summary form only. MULTIPLE PRODUCTION/phase space; ELECTRON-POSITRON INTERACTIONS/ annihilation; MUON-PROTON INTERACTIONS/deep inelastic scattering; MULTIPLICITY; ANNIHILATION; HADRONS; PROBABILITY; GEV RANGE 10-100; PARTICLE RAPIDITY; SPATIAL DISTRIBUTION; SCALE INVARIANCE; SCALING LAWS; SYMMETRY BREAKING; TRANSVERSE MOMENTUM

53702 (INIS-mf–12006, pp. 116) **Does string fragmentation reveal more than longitudinal phase space?.** Schulze, H.J. (Heidelberg Univ. (Germany, F.R.). Inst. fuer Theoretische Physik); Aichelin, J. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Published in summary form only. COLOR MODEL/multiple production; MULTIPLE PRODUCTION/phase space; STRING MODELS; LIMITING FRAGMENTATION; HADRONIC PARTICLE DECAY; HADRONS; TIME DEPENDENCE; MATRIX ELEMENTS; PERTURBATION THEORY; DECAY AMPLITUDES; TRANSVERSE MOMENTUM; LONGITUDINAL MOMENTUM; MULTIPLICITY; QUANTUM CHROMODYNAMICS; INCLUSIVE INTERACTIONS

53703 (INIS-mf–12006, pp. 116) **J/psi suppression.** Jaenicke, U. (Heidelberg Univ. (Germany, F.R.). Inst. fuer Theoretische Physik); Huefner, J. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Published in summary form only. COLOR MODEL/particle production; PARTICLE PRODUCTION/j psi-3097 mesons; HADRON-HADRON INTERACTIONS/particle production; SPACE DEPENDENCE; TIME DEPENDENCE; STRING MODELS; OBE MODEL; GLUON MODEL; LIMITING FRAGMENTATION; ELECTRIC FIELDS

53704 (IPNO-TH–88-02) **New UA4 rho ^{a}ntip^p datum and the odderon.** Nicolescu, B. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. Jan 1988. 12p. (CONF-8710274–: 2. international conference on elastic and diffractive scattering, New York, NY (USA), 15-18 Oct 1987). Order Number DE90713775. Available from NTIS (US Sales Only), PC A03/MF A01.

We show that the surprising high value of the ratio of the real to the imaginary part of the forward antipp amplitude measured recently at the CERN collider, rho ^{a}ntip^p = 0.24 +- 0.04, can be well described by the presence of the odderon in the crossing-odd amplitude. Several consequences of our interpretation will be testable at Tevatron energies and beyond.

53705 (LAPP-EXP–88-20) **Analysis of the reaction $\pi^-p \to \pi^0$eta n at 100 GeV.** Boutemeur, M.; GAMS-NA12 Collaboration. Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules. 1988. 8p. (CONF-8808272–: BNL Workshop on Glueballs, Hybrids and Exotic Hadrons, Brookhaven, U (USA), 29 Aug - 1 sep 1988). Order Number DE90713770. Available from NTIS (US Sales Only), PC A02/MF A01.

A partial wave analysis of the π^0eta angular distributions has been performed using three different methods. It clearly indicates the existence of a resonance with exotic quantum numbers: $J^{PC} = 1^{-+}$, $I^G = 1^-$ at $M_{\pi 0 eta} \simeq 1400$ MeV. This is the first observation of a meson that can in no way be a qantiq state. A new peak is also observed in the S wave at $M_{\pi 0 eta} \simeq 1300$ MeV, it could be the regular a_0 member of the $^3P_0$ scalar nonet.

53706 (NBI-HE–89-30) **Topological solitons of the Nambu-Jona-Lasinio model.** Reinhardt, H.; Wuensch, R. Niels Bohr Inst., Copenhagen (Denmark). Jun 1989. 16p. Order Number DE90712108. Available from NTIS (US Sales Only), PC A03/MF A01.

The baryon number one soliton solution of the Nambu-Jona-Lasinio model are found numerically in the mean-field approximation with full inclusion of the Dirac sea using the proper-time regularization for the underlying fermion determinant (quark loop). Explicit breaking of chiral symmetry is included by bare (current) quark masses. The obtained lowest-energy chiral soliton solutions with baryon number one carry winding number one. Fitting the parameters of the model from low-energy pion data the classical energies of these solitons are of the order of the nucleon mass. (orig.).

53707 (PITHA–89/11) **Measuring static quark properties at LEP.** Djouadi, A.; Spira, M. Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Experimentalphysik 3B und 3. Physikalisches Inst. 1989. 8p. Available from Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Experimentalphysik 3B und 3. Physikalisches Inst.

The measurement of the hadronic Z branching ratios and jet angular distributions can set stringent limits on static quark properties, radii and anomalous (Z) magnetic moments. For heavy quarks, in particular the third generation, e^+e^- annihilation is the only method to measure these quantities. Bounds on radii of the order 10^{-16} cm down to 10^{-17} cm can be expected from LEP experiments. The radii and magnetic moments can be interrelated in phenomenological models for quark substructures. (orig.).

53708 (PITHA–89/12) **(eb), (et) type leptoquarks at ep colliders.** Djouadi, A.; Spira, M.; Koehler, T.; Tutas, J. Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Experimentalphysik 3B und 3. Physikalisches Inst. 1989. 16p. Available from Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Experimentalphysik 3B und 3. Physikalisches Inst.

Leptoquarks with quantum numbers of (eb) and (et) compounds can be generated in electron-gluon collisions. Production rates and signatures are discussed for HERA energies and beyond. (orig.).

53709 (RAL–89-047) **Charm quark contribution to the W and Z cross sections at pp-bar colliders.** Martin, A.D.; Stirling, W.J.; Roberts, R.G. Rutherford Appleton Lab., Chilton (UK). Jun 1989. 15p. (DTP–89-18). Order Number DE90606097. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The ratio R of the cross sections for pp-bar -> W -> $l\nu$ and pp-bar -> Z -> l^+l^- is one of the most important precision measurements at present day pp-bar colliders. In previous studies we have investigated some of the theoretical uncertainties in the calculation of this ratio. We further refine the analysis by considering the uncertainty coming from the charm quark content of the nucleon. We show that data on the charm quark contribution to deep inelastic structure function F_2 are already sufficiently precise to place limits on this uncertainty, and we conclude that the charm quark uncertainty in the ratio of W and Z cross sections does not pose a serious problem. We predict that R = 10.4 +- 0.1 at $\sqrt{s}$ = 1.8 TeV if N_ν = 3 and $m_t > M_W$. (author).

53710 (SLAC-PUB–5088) **Tests of quantum chromodynamics in exclusive e^+e^{minus} and $\gamma\gamma$ processes.** Brodsky, S.J. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Sep 1989. 35p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8905144–13: Tau-Charm workshop, Stanford, CA (USA), 23-27 May 1989). Order Number DE90000938. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This paper discusses the following topics: Factorization theorem for exclusive processes; Electromagnetic form factors of baryons; Suppression of final state interactions; The $\gamma\pi_0$ Transition form factor; Exclusive charmonium decays; The π-ρ puzzle; Time-like compton processes; Multi-hadron production; Heavy Quark exclusive states and form factor zeros in QCD; Exclusive $\gamma\gamma$ reactions; Higher twist effects; and Tauonium and threshold $\tau^+\tau^-$ production. 41 refs., 15 figs. (LSP)

53711 (TRI-PP–89-51) **Present status of CP violation.** Ng, J.N. British Columbia Univ., Vancouver, BC (Canada). TRIUMF Facility. Jun 1989. 7p. (CONF-8905187–4: WEIN '89: international symposium on weak and electromagnetic interactions in nuclei, Montreal (Canada), 15-19 May 1989). Order Number DE90001190. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI.

A review of the status of CP violation in kaons is given. Status of our knowledge of quark mixing angles in the standard six quark model is presented. The role B_d^0–$\bar{B}_d^0$ transition plays in this study is examined. A comparison of the estimates of CP violation effects from models beyond the standard one is given. Other experiments that have the capability of testing different CP violation models are also discussed. 35 refs., 6 figs., 1 tab.

53712 (TRI-PP–89-52) **Lepton flavor conserving rare pion and kaon decays.** Numao, T. British Columbia Univ., Vancouver, BC (Canada). TRIUMF Facility. Jun 1989. 3p. (CONF-8906160–4: Yamada conference on nuclear weak process and nuclear structure, Osaka (Japan), 12-15 Jun 1989). Order Number DE90001187. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI.

The standard model of electro-weak interaction has been very successful in explaining every phenomenon in a wide energy region, less than eV to 100 GeV. There seems to be little conflict between the standard model predictions and experimental results. However, it is not expected to be the ultimate theory because the standard model contains so many free parameters to be put in by hand. It doesn't answer the question of the existence of multiple seemingly redundant generations (or flavors) of leptons, either; each lepton generation seems to identically couple to the charged weak bosons (universality) and to have its own quantum number. Experimentally, there are still several unknown parameters in the standard model, such as the top-quark mass and Kobayashi-Maskawa matrix elements. In order to test the standard model further, they should be known or determined more accurately. Rare decays of pions and kaons can provide tight constraints on many unknown parameters. In addition, rare decays are hindered by some mechanism, which usually results on an extreme sensitivity to a certain type of interactions. For instance, the decay $\pi^+ \rightarrow e^+\nu$ is suppressed by helicity effects, which make the decay $\pi^+ \rightarrow e^+\nu$ a sensitive test for a presence of helicity-unsuppressed pseudo-scalar coupling. The standard model prediction could crucially be charged by precise measurements of rare decays of light sources. 8 refs., 3 figs.

53713 (UWThPh–1988-29) **Role of resonances in chiral perturbation theory.** Ecker, G.; Gasser, J.; Pich, A.; Rafael, E. de. Vienna Univ. (Austria). Inst. fuer Theoretische Physik. Sep 1988. 33p. (CERN-TH–5185/88;CPT–88/PE.2158). Order Number DE90603557. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The strong interactions of low-lying meson resonances (spin $\leq$ 1) with the octet of pseudoscalar mesons (π,K,eta) are considered to lowest order in the derivative expansion of chiral SU(3). The resonance contributions to the coupling constants of the $O(p^4)$ effective chiral lagrangian involving pseudoscalar fields only are determined. These low-energy coupling constants are found to be dominated by the resonance contributions. Although we do not treat the vector and axial-vector mesons as gauge bosons of local chiral symmetry, vector meson dominance emerges as a prominent result of our analysis. As a further application of chiral resonance couplings, we calculate the electromagnetic pion mass difference to lowest order in chiral perturbation theory with explicit resonance fields. 29 refs., 2 figs., 5 tabs. (Author).

53714 **Towards an understanding of the generation problem.** Robinson, J.A. Thesis (Ph. D.). 166p. Iowa State Univ., Ames, IA (US) (1987). Available from University Microfilms, PO Box 1764, Ann Arbor, MI 48106, Order No.88-05,134.

In this study, Hermitian quark mass matrices for three generations and the Kobayashi-Maskawa mixing matrices which they produce are studied. The investigation is limited to mass matrices which depend on only three parameters. It was found that the Fritzsch mass matrix is the unique matrix consisting of five nonzero elements. Then proceeding to classify physically distinct mass matrices having six or seven nonzero elements, it was found that several produce mixing matrices that are in good agreement with experimental constraints. Next, constraints obtained from the CP violation parameter ε, B^0-$\bar{B}^0$ mixing, and the recent observation of charmless B-decays are imposed. For these matrices values for ε'/ε are calculated and compared to the current experimental limits. It was found that the results from charmless B-decays effectively eliminates the Fritzsch scheme as a realistic three generation model. On the other hand, several of the other mass matrices examined are found to be in good agreement with the most recent experimental and theoretical limits. Finally, the possibility of placing limits on the composite structure of the W boson is examined by looking for form-factor effects as well as a W anomalous magnetic moment (μ_W) in the processes $W \rightarrow e\nu\gamma$, $\gamma e \rightarrow W\nu$, and $\nu \rightarrow W\gamma$. The most sensitive reaction to variation in the magnetic-moment parameter κ_W is $\gamma e \rightarrow W\nu$, which should be accessible at the Stanford Linear Collider and CERN LEP. It was found that all three processes are quite sensitive to form factor effects for a compositeness scale in the range 100 GeV < Λ < 350 GeV. From these reactions future experiments should be able to observe W compositeness from the effects of a nonstandard κ_2, form factors, or both.

53715 **Probing vacuum stability bounds at the Fermilab Collider.** Lindner, M. (Fermi National Accelerator Lab., Batavia, IL (USA)); Sher, M.; Zaglauer, H.W. *Physics Letters [Section] B (Netherlands)*, 228(1): 139-143 (7 Sep 1989).

If the top quark mass is above 86 GeV, then a stringent lower bound on the mass of the Higgs boson arises from the requirement of vacuum stability. We calculate the bound as precisely as possible by numerically solving the renormalization group equations to two-loop order. If the lower bound on the top mass is 100 (110, 120) GeV, the lower bound to the Higgs mass is found to be 20 (34, 50) GeV. Thus, if the standard model is correct, then a nondiscovery of the top quark at the Fermilab Collider implies that the Higgs boson cannot be discovered at CUSB, SLC or LEP I. (orig.).

53716 **Signals of "new physics" in high-energy cosmic-ray interactions.** Domokos, G. (Department of Physics and Astronomy, The Johns Hopkins University, Baltimore, Maryland 21218 (US)); Elliott, B.; Kovesi-Domokos, S.; Mrenna, S. *Physical Review Letters (USA)*, 63(8): 844-847 (21 Aug 1989).

In some composite models of quarks and leptons, leptons are expected to develop strong interactions at high energies. This hypothesis can be tested by studying the absorption of high-energy particles emitted by point sources in the sky on the cosmic microwave background. Data on Cygnus X-3 exhibit an anomaly in the absorption. A plausible interpretation of the anomaly is that some of the interactions are caused by neutrinos. We infer that the cross section of neutrino-nucleon interactions is approximately 6 mb at energies of a few PeV, significantly exceeding the prediction of the standard model.

6453 Particle Invariance Principles and Symmetries

Refer also to citation(s) 53727

53717 (CNIC–00213) **Comments on a definition of maximal CP violation.** Zhang Zhiqing; Wu Dandi; Huang Tao. China Nuclear Information Centre, Beijing, BJ (China). Jun 1988. 8p. Order Number DE90603010. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

In the weak basis with diagonalized up quark mass matrix and Hermitian down quark mass matrix, the sequential product of the diagonal elements $M_{1/2}$sup d/$M_2 3^d$ $M_3 1^d$ is a phase convention independent quantity. The idea of using the argument of this product to define maximal CP violation was examined, along with other definitions. The argument in reality is not $\pi/2$ allowing experimental and theoretical uncertainties.

53718 (FNAL/C–89/167-T) **R-parity breaking in low energy supergravity models.** Giudice, G.F. Fermi National Accelerator Lab., Batavia, IL (USA). Aug 1989. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-8905223–1: 12. Warsaw symposium on elementary particle physics, Kazimierz (Poland), 29 May - 2 jun 1989). Order Number DE90000780. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The existence of R-parity violating interactions in supersymmetric models leads to various rare processes at low energies, deviations from the standard model predictions on weak interactions and new signals in collider experiments. The present limits on R-violating couplings in the minimal low energy supergravity model are derived. The effects of R-parity violation on the experimental search for supersymmetry are also briefly discussed. 9 refs.

53719 (LAPP-TH–225-88) **Superstring inspired phenomenology.** Binetruy, P. Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules. 1988. 27p. (CONF-8804184–: 9. workshop on grand unification, Aix-Les-Bains (France), 27-30 Apr 1988). Order Number DE90713784. Available from NTIS (US Sales Only), PC A03/MF A01.

Recent progress in superstring model building is reviewed with an emphasis on the general features of the models obtained. The problems associated with supersymmetry breaking and intermediate gauge symmetry breaking ($M_W < M_I < M_{GUT}$) are described. Finally, the phenomenology of these models is summarized, with a discussion of the role that new experimental results could play to help clearing up the above difficulties.

53720 (NORDITA–89/21-P(prepr.)) **Informal introduction to extended algebras and conformal field theories with $c \geq 1$.** Ravanini, F. Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark). 1989. 51p. (CONF-8904277–: Program on string and conformal field theory, Copenhagen (Denmark), Apr 1989). Order Number DE90712067. Available from NTIS (US Sales Only), PC A04/MF A01.

We review some of the topics of Conformal Field Theory, like extended algebras, parafermions, coset constructions and generalized Feigin-Fuchs construction, modular invariant partition functions on the torus and the help they give in classification of CFTs. Some recent issues in RCFT are also discussed. (orig.).

53721 (RRK–89-12) **Superparticle on the super Riemann surface.** Matsumoto, Shuji; Yasui, Yukinori; Uehara, Shozo. Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics. Apr 1989. 72p. Order Number DE90710099. Available from NTIS (US Sales Only), PC A04/MF A01.

Free motion of a nonrelativistic superparticle on the super Riemann surface (SRS) of genus $h \geq 2$ is investigated. Geodesics or classical paths are given explicitly on the super Poincare upper half plane SH, a universal covering space of the SRS, and the paths with some suitable initial conditions yield periodic orbits on the SRS. The periodic orbits are unstable and the system is chaotic. Quantum mechanics is solved on the universal covering space SH. And the heat kernel is given on the SRS. This leads a super analog of the Selberg trace formula. The Selberg super zeta function is introduced whose zero-points and poles determine the energy spectrum on the SRS. (author).

53722 **Effect of cascade decays on the Fermilab Tevatron gluino and squark mass bounds.** Baer, H. (Physics Department, Florida State University, Tallahassee, Florida 32306 (US)); Tata, X.; Woodside, J. *Physical Review Letters (USA),* 63(4): 352-355 (24 Jul 1989).

The CDF (Collider Detector Facility) collaboration has recently announced limits on the masses of squarks and gluinos assuming that they decay directly to a massless lightest supersymmetric particle (LSP). We examine how these mass limits change when realistic squark and gluino decays to all gauginos are incorporated and the LSP mass is given by the minimal supergravity model. The gluino mass is diminished by 3–30 GeV as we vary the model parameters over their complete range. The squark mass limit is typically reduced by $\lesssim$10 GeV if m(LSP)$\lesssim$20 GeV.

53723 **Calabi-Yau manifold of four generations.** Rusjan, E. (Center for Transport Theory and Mathematical Physics, Virginia Tech, Blacksburg, Virginia 24061 (YU)); Senjanovic, G.; Sokorac, A. *Physical Review [Section] D: Particles and Fields (USA),* 40(4): 1166-1175 (15 Aug 1989).

We analyze in detail a recently proposed four-generation superstring model, based on an algebraic variety in $CP_4 \times CP_4$. The group of honest symmetries G_H of the manifold is identified and the transformation properties of the light fields under G_H are given. We also discuss the flux breaking of E_6 symmetry, identify the candidates for matter parity, and analyze supersymmetry breaking. For the Pati-Salam version of the theory we isolate the light fields of the theory and discuss the issues of the naturally light Higgs field(s) and the resulting fermionic mass matrices.

6454 Field Theory

Refer also to citation(s) 53616, 53617, 53618, 53718, 53720, 53723

53724 (BiBoS–363/89) **Path integrals over Poisson trajectories: Analytical and numerical estimates of ground state energies.** Bolz, G.F.; Serva, M. Bielefeld Univ. (Germany, F.R.). Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS). Mar 1989. 10p. (CONF-8807193–: Conference on stochastic processes - geometry and physics, Como (Italy), Jul 1988). Available from Bielefeld Univ. (Germany, F.R.). Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS).

The aim of this contribution is to demonstrate both a path integral method based on birth and death processes and a related numerical technique by applying them to a simple (but nontrivial) model of an electron in interaction with a boson field mode. (orig.).

53725 (CNIC–00228) **Proton Decay including extra Z^0 bosons.** Li Tiezhong. China Nuclear Information Centre, Beijing, BJ (China). Jun 1988. 7p. Order Number DE90602982. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

There exists an apparent discrepancy between proton decay experiment and simplest SU(5) prediction. Author suggested a scheme: if there exists an extra Z^0 boson then the experimental value of the proton decay may be caluclated from GUT and the good results of SU(5) can be preserved. The increasing fermions will be not bizarre.

53726 (CRN-HE–89-01) **Regularization of the path integral measure for anomalies.** Umezawa, M. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1989. 33p. Order Number DE90713772. Available from NTIS (US Sales Only), PC A03/MF A01.

In this paper we show that the variation of the integral measure is fully equivalent to the authentic field theoretical treatment for a two-point function. To do this we first examine various ways of solving the factor A(x) in Fujikawa's expression for the functional integral measure. We define the anomaly as $A(x)$-A_f (x), where $A_f(x)$ is the Fujikawa factor for the free field. We then propose a regulator which leads to a finite result for any anomaly. We then show that the A(x) can be defined in terms of the proper-time through a splitting procedure. The original Fujikawa prescription for A(x) is shown to be closely related to the proper-time description of the anomaly, initiated by Schwinger. Its equivalence to the authentic field theoretical treatment will be proven as a consequence of these investigations. The ξ-functional regularization for A(x) is also examined. Then we will examine the way to deduce the anomaly from the effective potential by adopting the PHI^4 model as an example. The renormalization group equation for the effective potential is solved exactly to obtain the precise form of the β-function in terms of which we reexpress the result obtained in a previous section for A(x). We discuss the physical significance of the renormalization group equation for the case of broken symmetry.

53727 (DOE/ER/10713–9A) **[Investigations in guage theories, topological solitons and string theories]: Progress report.** Chang, L.N.; Tze, C.H. Virginia Polytechnic Inst., Blacksburg, VA (USA). [1989]. 27p. Sponsored by U.S. DOE Energy Research. DOE Contract AS05-80ER10713. Order Number DE90001116. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This report discusses the following topics: Phases and conservation laws in parametrized systems; Time reversal symmetry in 2 + 1 dimemsional systems; Chiral symmetry breaking in QCD at high temperatures; Solitons at Tev energies; Self-Duality, conformal symmetries and hypercomplex analyticity; Hopf phase entanglements, exotic membranes and division algebras; and Non-perturbative methods. 58 refs. (JSP)

53728 (DOE/ER/40233–4) **Topics in gauge theories and the unification of elementary particle interactions: Progress report, April 1, 1988–February 28, 1989.** Srivastava, Y.N.; Vaughn, M.T. Northeastern Univ., Boston, MA (USA). Feb 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-85ER40233. Order Number DE90001455. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

We report on work done by the principal investigators (Y.N. Srivastava and M.T. Vaughn) and their collaborators on non-scaling phenomena in very high-energy, low p_t physics; vacuum polarization effects in QED and in the standard model for macroscopic systems; and topological (and non-topological) solutions to classical field equations and their computer graphic representations.

53729 (JINR-D–17-88-95, pp. 257-264) **Thermo field dynamics: a quantum field theory at finite temperature.** Mancini, F. (Salerno Univ. (Italy). Ist. di Fisica); Marinaro, M.; Matsumoto, H. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. (CONF-8708341–: 4. international symposium on selected topics in statistical mechanics, Dubna (USSR), 25-29 Aug 1987). In *4. International symposium on selected topics in statistical mechanics*. Order Number DE90705928. Available from NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS.

A brief review of the theory of thermo field dynamics (TFD) is presented. TFD is introduced and developed by Umezawa and his coworkers at finite temperature. The most significant concept in TFD is that of a thermal vacuum which satisfies some conditions denoted as thermal state conditions. The TFD permits to reformulate theories at finite temperature. There is no need in an additional principle to determine particle distributions at T not = 0. Temperature and other macroscopic parameters are introduced in the definition of the vacuum state. All operator formalisms used in quantum field theory at T=0 are preserved, although the field degrees of freedom are doubled. 8 refs.

53730 (LAPP-TH–237-89) **Finite temperature QCD corrections to lepton-pair formation in a quark-gluon plasma.** Altherr, T. Grenoble-1 Univ., 74 - Annecy; Lab. de Physique des Particules); Aurenche, P. Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules. Feb 1989. 18p. Order Number DE90713766. Available from NTIS (US Sales Only), PC A03/MF A01.

We discuss the $O(\alpha_S)$ corrections to lepton-pair production in a quark-gluon plasma in equilibrium. The corrections are found to be very small in the domain of interest for ultrarelativistic heavy ions collisions. Interesting effects, however, appear at the annihilation threshold of the thermalized quarks.

53731 (LA-UR–89-3311) **QCD [Quantum Chromo-Dynamics] with dynamical fermions on the connection machine.** Baillie, C.F.; Brickner, R.G.; Gupta, R.; Johnsson, L. Los Alamos National Lab., NM (USA). 1989. 9p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. (CONF-891149–6: Supercomputing '89 conference, Reno, NV (USA), 13-17 Nov 1989). Order Number DE90001825. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We have implemented Quantum Chromo-Dynamics (QCD) on the massively parallel Connection Machine in *Lisp. The code uses dynamical Wilson fermions and the Hybrid Monte Carlo Algorithm (HMCA) to update the lattice. We describe our program and give performance measurements for it. With no tuning or optimization, the code runs at approximately 500 to 1000 MFLOPS on a 64-K Connection Machine, model CM-2, depending on the VP ratio.

53732 (NBI-HE–89-31) **Casimir energy for a piecewise uniform string.** Brevik, I.; Nielsen, H.B. Niels Bohr Inst., Copenhagen (Denmark). Jul 1989. 17p. Order Number DE90712109. Available from NTIS (US Sales Only), PC A03/MF A01.

The Casimir energy for the transverse oscillations of a piecewise uniform closed string is calculated. The string consists of two parts I and II, endowed in general with different tensions and mass densities, although adjusted in such a way that the velocity of sound always equals the velocity of light. The dispersion equation is worked out under general conditions, and the frequency spectrum is determined in special cases. When the ratio L_{II}/L_I between the string lengths is an integer, it is in principle possible to determine the frequency spectrum through solving algebraic equations of increasingly high degree. The Casimir energy relative to the uniform string is in general found to be negative, although in the special case L_I=L_{II} the energy is equal to zero. Delicate points in the regularization procedure are discussed; they point toward an anomaly in the theory. (orig.).

53733 (RRK–89-13) **Abelian gauge theory in topologically non-trivial space.** Hosoya, Akio; Soda, Jiro. Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics. May 1989. 10p. Order Number DE90710100. Available from NTIS (US Sales Only), PC A02/MF A01.

We quantize the (1+1)-dimensional Abelian gauge theory on cylinder to illustrate our idea how to extract global modes of topological orign. A new analysis is made for the (2+1)-dimensional Maxwell theory on T^2(torus) x R(time). The dynamics is explicitly given for the Wilson loops around cycles of the torus with arbitrary moduli parameters. We also discuss an extension to antisymmetric tensor fields in higher dimensions. (author).

53734 **Hard diffractive processes.** Berger, E.L. (High Energy Physics Div., Argonne National Lab., Argonne, IL (US)); Collins, J.C.; Soper, D.E.; Sterman, G. pp. 657 of Physics simulations at high energy. Barger, V. Gottschalk, T. Halzen, F. World Scientific Pub. Co., Teaneck, NJ (1987).

The authors discuss high energy hadron collisions that contain a hard scattering, in the sense that a W, a Z, very heavy quarks, or high P_T jets are produced, yet are diffractive, in the sense that one of the incident hadrons is scattered with only a small energy loss. In their approach, the cross section for such diffractive hard scattering is a part of the normal hard scattering inclusive cross section, as calculated using perturbative quantum chromodynamics. They use Regge phenomenology in combination with perturbative QCD to estimate that a substantial fraction (perhaps 30%) of all hard scattering events are diffractive. Measurement of diffractive hard scattering cross sections would illuminate the short distance gluon and quark content of the Pomeron.

53735 **Diffractive heavy flavor production-including W^{+-} and Z^0.** White, A.R. (High Energy Physics Div., Argonne National Lab.,

Argonne, IL (US)). pp. 657 of Physics simulations at high energy. Barger, V. Gottschalk, T. Halzen, F. World Scientific Pub. Co., Teaneck, NJ (1987).

It is shown that when the Pomeron has the semiperturbative origin in QCD described in a companion talk, diffractive heavy quark production is independent from, and not suppressed relative to, the perturbative gluon fusion process. It is emphasized that anomalously large diffractive heavy flavor cross-sections could anticipate correspondingly large cross-sections for the diffractive production of W^{+-} and Z^0-providing distinctive evidence for the dynamical nature of the electroweak Higgs sector.

53736 **Ghosts and the *c* theorem.** Mende, P.F. (Department of Mathematics and Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139 (US)). *Physical Review Letters (USA),* 63(4): 344-347 (24 Jul 1989).

We discuss the central charge in continuous families of two-dimensional conformal field theories. In a nonunitary conformal field theory the *c* theorem does not hold: A critical line can have a continuously varying central charge. This is illustrated with the bosonic-string ghost system and may pose difficulties for attempts to formulate string theory on the space of 2D field theories.

53737 **Aspects of dynamical symmetry breaking in gauge field theories.** Bardeen, W.A. (Fermi National Accelerator Lab., Batavia, IL (USA)); Leung, C.N.; Love, S.T. *Nuclear Physics [Section] B (Netherlands),* 323(3): 493-512 (11 Sep 1989).

The dynamics of chiral and scale symmetry breaking in quenched, planar QED is further examined. Particular attention is focused on the renormalization properties of the model and the relevance of the four-fermion operators. In accordance with our previous results, the scale symmetry is explicitly broken and the dilaton is not found at either strong or weak coupling. An effective lagrangian simultaneously realizing both spontaneously broken scale and chiral symmetries is constructed. (orig.).

53738 **Bosonization of Z_N parafermions.** Griffin, P. (Stanford Linear Accelerator Center, CA (USA)); Nemeschansky, D. *Nuclear Physics [Section] B (Netherlands),* 323(3): 545-571 (11 Sep 1989). DOE Contract AC03-76SF00515;FG03-84ER40168.

We develop a general method of solving non-trivial conformal field theories by coset imbeddings into free boson models. In particular, we consider Z_N parafermion models represented by the coset model constructions $su(N_1) + su(N)_1/su(N)_2$, and bosonize the $su(N)_1$ models. The calculation of correlation functions of these parafermion theories is formulated so that detailed information from the diagonal $su(N)_2$ theory is not required. A differential equation for the four-point function of order operators σ_1 is derived as an example. We also derive differential equations with respect to the modular parameter tau for the parafermion characters in terms of the $su(N)_1$ characters only. In particular, the equations for the Z_2 and Z_3 characters are first and second order respectively. (orig.).

53739 **Interacting Lagrangian for massive spin-two field.** Nappi, C.R. (The Institute for Advanced Study, Princeton, New Jersey 08540 (US)); Witten, L. *Physical Review [Section] D: Particles and Fields (USA),* 40(4): 1095-1100 (15 Aug 1989).

As is well known, Kaluza-Klein compactification of five-dimensional gravity gives a four-dimensional theory of a tower of massive spin-2 fields interacting with background gravitational, electromagnetic, and scalar fields. Working to lowest order in the massive fields, one can obtain a Lagrangian for a single massive spin-2 field interacting with gravitational and other background fields which is consistent up to terms of higher order in the massive spin-2 field. This consistency depends on massive spin-2 gauge invariances which are valid up to terms of higher order in the massive field. We explicitly exhibit the four-dimensional Lagrangian and its gauge transformations. This analysis parallels a similar analysis in string theory carried out elsewhere.

53740 **Sigma-model duality and duality transformations in string theory.** Molera, J.M. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104-6396 (US)); Ovrut, B.A. *Physical Review [Section] D: Particles and Fields (USA),* 40(4): 1146-1149 (15 Aug 1989).

Duality symmetries in the partition functions of closed strings compactified on tori and orbifolds are shown to be a direct consequence of the quantum-level field-theory duality of the associated two-dimensional σ models. This is demonstrated on both genus-0 and genus-1 world sheets.

53741 **Effective field theory from a β function for the *p*-adic string.** Nishino, H. (Department of Physics and Astronomy, University of North Carolina, Chapel Hill, North Carolina 27599-3255 (US)); Okada, Y.; Ubriaco, M.R. *Physical Review [Section] D: Particles and Fields (USA),* 40(4): 1153-1165 (15 Aug 1989).

We describe the calculation of a β function for the *p*-adic string σ model in a tachyonic background, and show that the vanishing condition of the β function reproduces the tachyonic field equation obtained from *p*-adic amplitude calculations, up to the fifth order in the tachyonic field. By examining this σ model in the presence of a soliton background, we show that a previously obtained soliton solution of the all-order tachyonic field equation follows from the requirement of discrete scale invariance.

53742 **Effective one-loop Lagrangian for nonlinear σ models coupled to gravity.** Jain, V. (Department of Physics, University of California and Theoretical Physics Group, Physics Division, Lawrence Berkeley Laboratory, 1 Cyclotron Road, Berkeley, California 94720 (US)). *Physical Review [Section] D: Particles and Fields (USA),* 40(4): 1213-1220 (15 Aug 1989). DOE Contract AC03-76SF00098.

A simple application of covariant-derivative expansion techniques to compute the divergent one-loop contributions to the effective action for a nonlinear σ model coupled to gravity is presented. The results are then applied to a class of superstring-inspired supergravity models.

53743 **Wilson loops in three dimensions.** Cahill, K. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138, Division de Physique Theorique, Institut de Physique Nucleaire, Universite de Paris-Sud, 91406 Orsay, France (US)); Prasad, S. *Physical Review [Section] D: Particles and Fields (USA),* 40(4): 1274-1292 (15 Aug 1989).

For a pure gauge theory in three dimensions with a compact, semisimple gauge group, we derive a formula for Creutz ratios of Wilson loops that is valid in the continuum theory to fourth order in the coupling constant. For $SU(2)_3$, we compare this perturbative formula, corrected for periodic boundary conditions, with lattice Creutz ratios that we have measured both in compact simulations guided by Wilson's or Manton's action and in noncompact simulations guided by the Yang-Mills action. The noncompact simulations show no evidence of quark confinement. We also present a critique of compact lattice methods and discuss the renormalization of both compact and noncompact simulations.

53744 **The δ expansion and local gauge invariance.** Bender, C.M. (Department of Physics, Washington University, St. Louis, Missouri 63130 (US)); Cooper, F.; Milton, K.A. *Physical Review [Section] D: Particles and Fields (USA),* 40(4): 1354-1355 (15 Aug 1989).

A recently proposed approximation method, called the δ expansion, was introduced in the context of a self-interacting scalar field theory. This approximation method offers the hope of obtaining nonperturbative information about a quantum field theory using perturbative techniques. In this paper we extend formally the δ-expansion methods to field theories having local gauge symmetry. We then compute the anomaly in the Schwinger model.

65 PHYSICS II

6510 Nuclear Physics

53745 (CONF-890826–4) **Heavy Ion interactions.** Schiffer, J.P. Argonne National Lab., IL (USA). [1989]. 20p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. From International nuclear physics conference; Sao Paulo (Brazil); 20-26 Aug 1989. Order Number DE90001410. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Nuclear Physics has come a long way since its inception 70 years ago. We have learned a great deal about nuclear structure and nuclear interactions – and we have a lot to learn yet. Our understanding of the substructure of protons and neutrons in terms of their 'elementary' constituents has also evolved to the present level of QCD and the Standard Model. Early work on nuclear reactions involving light projectiles did a great deal in elucidating the characteristic nuclear symmetries and the dynamic phenomena associated with nuclei. As accelerator and ion source technologies evolve it has become possible to accelerate heavier nuclei in addition to electrons, protons, and the very light nuclear systems. From these developments in the tools of our science we are deriving new knowledge: learning about otherwise inaccessible nuclear properties, of the dynamic characteristics of nuclear matter, and about the production of mesons, antiparticles, and other exotic objects in the collision of complex nuclear systems. The subject cuts across much of nuclear physics and it is difficult to give a cohesive overview talk. But I would like to attempt giving you the current flavors of the subject. 18 figs.

53746 (DOE/ER/40145–4) **Research in theoretical nuclear physics: Progress report, November 1, 1988–October 31, 1989.** Texas Univ., Austin, TX (USA). Dept. of Physics. Oct 1989. 54p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-84ER40145. Order Number DE90001402. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This report discusses the following topics in nuclear physics: reactions induced by light ions; reactions induced by heavy ions; medium energy physics; and nuclear collective motions. (LSP)

53747 (DOE/ER/40269–T2) **[Intermediate energy nuclear physics]: Progress report, October 1, 1988–October 1, 1989.** Colorado Univ., Boulder, CO (USA). 1 Oct 1989. 69p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-86ER40269. (NPL–1056). Order Number DE90001944. Available from NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.

This report summarizes work in experimental Intermediate Energy Nuclear Physics carried out between October 1, 1988 and October 1, 1989 at the Nuclear Physics Laboratory of the University of Colorado, Boulder, under grant DE-FG02-86ER-40269 with the United States Department of Energy. The experimental program is very broadly based, including pion-nucleon studies at TRIUMF, inelastic pion scattering and charge exchange reactions at LAMPF, and nucleon charge exchange at LAMPF/WNR. In addition, a number of other topics related to accelerator physics are described in this report.

53748 (DOE/ER/40285–3) **A program in medium-energy nuclear physics: Technical progress report, August 1988–September 1989.** Berman, B.L.; Dhuga, K.S. George Washington Univ., Washington, DC (USA). 1989. 35p. Sponsored by U.S. DOE Energy Research; National Science Foundation. DOE Contract FG05-86ER40285. Order Number DE90001233. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This report discusses research done on the following topics: electron-scattering nuclear-structure studies; coincidence electrodisintegration studies of light nuclei; pion scattering and reactions on the three-body nuclei; and pion scattering from shell-model nuclei.

53749 (DOE/ER/40343–3) **Research in experimental nuclear physics: Progress report, April 1, 1987–March 31, 1990.** Moore, C.F. Texas Univ., Austin, TX (USA). Dept. of Physics. Sep 1989. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-87ER40343. Order Number DE90001401. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Our program concentrates on pion physics experimental results obtained using the Energetic Pion Channel and Spectrometer (EPICS), Pion and Particle Physics channel (P^3), and the Low Energy Pion physics channel (LEP). These facilities are unique in the world in their intensity and resolution. Two classes of experiments can be done best with this equipment: scattering (elastic and inelastic) and double charge exchange (DCX). Several coincidence experiments are in progress and are discussed in this paper.

53750 (INIS-BR–1662) **Hyperfine interaction studies with heavy ion beams: applications in nuclear physics.** Saxena, R.N. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). 1986. 17p. Order Number DE90606110. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Heavy ion reactions using pulsed beam had a great influence on the study of hyperfine interactions. Until recently the radioactivity or light-ion reactions have been used for such studies. Heavy-ion reactions however offer considerable advantage for systematic investigation of hyperfine interactions. In this review we shall describe the basic technique of time differential perturbed angular distribution (TDPAD) and recent applications to some problems in nuclear physics such as the measurements of nuclear magnetic and electric quadrupole moments of high spin isomers. (author).

53751 (INIS-mf–12006) **Max-Planck-Institute for Nuclear Physics. Annual report 1988.** Klapdor, H.V. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). Abt. fuer Kernphysik); Jessberger, E.K. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). Abt. fuer Kosmophysik) (eds.). Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. 200p. (In German). Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

This annual report contains short notes and abstracts about the work performed at the named institute together with a list of publications and talks. The work concerns technical developments of accelerators and ion sources, experimental and theoretical studies on nuclear structure and reactions, high-energy physics, studies on meteorites and lunar rocks, comets, interplanetary and interstellar dust, interstellar dynamics, nuclear geology, and archaeometry. See hints under the relevant topics. (HSI).

53752 (ISN–88-74) **Nuclear viscosity.** Suraud, E.; Gregoire, C. Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires. 1988. 37p. (In French). Order Number DE90713790. Available from NTIS (US Sales Only), PC A03/MF A01.

Heavy ion collisions permit to study the effects of nuclear viscosity, which represent the global consequence of the multiple nucleon-nucleon interactions during a collision. But the characteristic timelength of these phenomena is 10^{-22} s while the detectors precision hardly reach 10^{-9} s. It is therefore necessary to use a theoretical simulation. Only recently, a semi-classical approximation showed the nuclear-viscosity phenomenon. This approximation is represented by the Landau-Vlasov equation. Convenient solutions have recently be found. Less precise on the quantic point of view than the Hartree-Fock equation precedently used, Landau-Vlasov equation permits to study viscosity in nuclei, which is quite essential for the comprehension of two of the four fundamental interactions of nature.

53753 (ISN–89-15) **Charged pion ratio in heavy ion reactions at 93 MeV/u.** Lebrun, D.; Chauvin, J.; Rebreyend, D.; Perrin, G.; Saintignon, P. de; Martin, P.; Buenerd, M.; Le Brun, C.; Lecolley, J.F.; Cassagnou, Y. Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires. 1989. 11p. (CONF-8901120–: 27. international winter meeting on nuclear physics, Bormio (Italy), 23-27 Jan 1989). Order Number DE90713779. Available from NTIS (US Sales Only), PC A03/MF A01.

In heavy ion reaction, very low momentum pions can be a tool to study the space time geometry of the collision. Those pions suffer a strong electromagnetic interaction which is very sensitive to the shape of nuclear charge distribution after the collision took place. These coulomb distortions experimentally manifest as singularities in the pion momentum distributions for p-values matching those of nuclear products. Such distributions of very low energy charged pions were measured at low transverse momenta (zero degree), in production reactions induced by a 93 MeV/u oxygen beam from GANIL on various targets. For pion velocity close to the beam and below, very strong effects are seen in the ratio (N-/N+); values up to 100 are archived. Two main contributions can explain it. One comes from the fragmentation region which dominates in low mass systems. The other, whose influence increases drastrically with mass, is characterized by an intermediate size and velocity system. The dependence of the pion yield upon its size indicates this system is the source of pions.

53754 (JINR-E–3-89-506) **Nuclear structure and decay of compound states.** Popov, Yu.P. Joint Inst. for Nuclear Research,

Dubna (USSR). [1989]. 10p. (CONF-8906168–5: International conference on selected topics in nuclear structure, Dubna (USSR), 20-24 Jun 1989). Order Number DE90000716. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI.

The experimental data on the formation and decay of states at the neutron binding energy and below it (compound and pre-compound states), that were acquired in the last years, are considered to inquire into the nature (structure) of high excited states as well as of the processes of fragmentation of considerably simple excitation modes over compound states. An essential role of single particle excitations of compound and pre-compound states in the process of γ-decay of neutron resonances of heavy nuclei in the vicinity of a 4S-shell is indicated. 17 refs., 7 figs., 1 tab.

53755 (ORNL/FTR–3392) **[Evolution of nuclear collectivity at high spins and temperatures]: Foreign trip report, August 29, 1989–September 17, 1989.** Baktash, C. Oak Ridge National Lab., TN (USA). 28 Sep 1989. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90001251. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler attended and presented an invited talk entitled "Evolution of nuclear collectivity at high spins and temperatures" at the XII Workshop on Nuclear Physics at Iguazu Falls, Argentina. Following the conference, the traveler visited the TANDAR Laboratory in Buenos Aires, Argentina, for two weeks. This trip was the first by one of the principal investigators of an ORNL-TANDAR exchange program that was recently approved and funded by the NSF. The results of the extensive consultations that the traveler had with his Argentine collaborators, A. J. Kreiner and G. Garcia-Bermudez, can be summarized as follows: (1) discussed the spectroscopy work on several nuclei of common interest that are being studied at the two laboratories, (2) agreed on the first joint experiments to be performed at the Holifield and TANDAR facilities, (3) developed a tentative timetable for the future visits by both groups, and (4) continued with the analysis of data on ^{82}Sr taken earlier at ORNL in collaboration with Dr. Garcia-Bermudez.

53756 (ORNL/FTR–3399) **[The 1989 International Nuclear Physics Conference]: Foreign trip report, August 17, 1989–September 10, 1989.** Obenshain, F.E.; Plasil, F. Oak Ridge National Lab., TN (USA). 6 Oct 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90001243. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The travelers attended the 1989 International Nuclear Physics Conference in Sao Paulo, Brazil, and the International Workshop on Relativistic Aspects of Nuclear Physics in Rio de Janeiro. They presented talks and posters covering various aspects of the WA80 experiment at both meetings.

53757 (TRI-PP–89-65) **Gamow Teller strength from charge exchange reactions at intermediate energies.** Haeusser, O. Simon Fraser Univ., Burnaby, BC (Canada). Jul 1989. 3p. (CONF-8906160–6: Yamada conference on nuclear weak process and nuclear structure, Osaka (Japan), 12-15 Jun 1989). Order Number DE90001188. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI.

Detailed studies of the spin-isospin structure of nuclear excitations are possible at TRIUMF's medium resolution spectrometer using the (n,p), $(\vec{p},\vec{p}\,')$ and (p,n) reactions. We discuss here results on isospin symmetry of inelastic nucleon scattering reactions populating isospin triads in A=6 and A=12 nuclei. The β^+ Gamow Teller strength function from (n,p) reactions on (sd) and (fp) shell targets is found to be substantially quenched compared to current nuclear structure models using the free-nucleon axial-vector coupling constant. 22 refs., 3 figs.

53758 (TRI-PP–89-69) **Gamow-Teller strength from N-nucleus scattering.** Haeusser, O. British Columbia Univ., Vancouver, BC (Canada). TRIUMF Facility. Aug 1989. 5p. (CONF-8906168–4: International conference on selected topics in nuclear structure, Dubna (USSR), 20-24 Jun 1989). Order Number DE90001189. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI.

Detailed studies of the spin-isospin structure of nuclear excitations are possible at TRIUMF's medium resolution spectrometer using the (n, p),$(\vec{p},\vec{p}\,')$ and (p,n) reactions. We discuss here results on isospin symmetry of inelastic nucleon scattering reactions populating isospin triads in A=6 and A=12 nuclei. The empirical ratio of L=0 isovector spinflip cross sections at 200-450 MeV and B(GT) for strong Gamow-Teller transitions in p-shell nuclei is found to be larger than calculated in the DWIA using a free NN t-matrix. Based on empirical values of σ/B(GT) the β^+ Gamow-Teller strength function from (n,p) reactions on (sd) and (fp) shell targets is substantially quenched compared to current nuclear structure models using the free-nucleon axial-vector coupling constant. 33 refs., 6 figs.

6512 Nuclear Properties and Reactions, A=1-5, Experimental

Refer also to citation(s) 53673

53759 (INIS-mf–12006, pp. 48-50) **^{4}He(e,e'x) coincidence experiments for investigation of charge symmetry in ^{4}He.** Khan, S. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.)); Kihm, T.; Knoepfle, K.T.; Schulz, H.J.; Spahn, M.; Friedrich, J.; Voegler, N.; Schmitt, C.; Walther, V.H. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

^{4}He(e,e'c) coincidence electron scattering at low momentum transfer allows us to study for the first time simultaneously the p and n decay from the giant resonance region in ^{4}He below ω=30 MeV by detecting the charged particles c=p, ^{3}H and ^{3}He in the same detector systems. Careful data analysis yields the ratio $R_e=\sigma[^4He(e,e'p)]/\sigma[^4He(e,e'n)]$ in the excitation energy region $22<\omega<36$ MeV. (orig./HSI).

6513 Nuclear Properties and Reactions, A=6-19, Experimental

Refer also to citation(s) 53673, 53784

53760 (INIS-mf–12006, pp. 50-51) **The interference term between nuclear charge and nuclear current matrix elements of the E1 giant resonance in ^{12}C and ^{58}Ni.** Kihm, T. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.)); Khan, S.; Knoepfle, K.T.; Schulz, H.J.; Spahn, M.; Emrich, H.J. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Via the (e,e'p) reaction the longitudinal-transverse interference term of the nuclear response function has been measured in the giant dipole resonance region of ^{12}C and ^{58}Ni by exploiting its explicit $\cos\phi_p$ dependence; ϕ_p is the azimuthal emission angle of the proton with respect to the axis of momentum transfer. (orig.).

53761 (TRI-PP–89-54) **Radiative muon capture in light nuclei.** Hasinoff, M.D.; Ahmad, S; Armstrong, D.S.; Azuelos, G.; Bertl, W.; Blecher, M.; Burnham, R.A.; Clifford, E.T.H.; Chen, C.Q.; Ding, Z.H.; Depommier, P.; Gorringe, T.P.; Henderson, R.; Larabee, A.J.; Macdonald, J.A.; Mes, H.; Numao, T.; Poutissou, J.M.; PoutBritish Columbia Univ., Vancouver, BC (Canada). TRIUMF Facility. Jun 1989. 3p. (CONF-8906160–5: Yamada conference on nuclear weak process and nuclear structure, Osaka (Japan), 12-15 Jun 1989). Order Number DE90001186. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI.

Radiative muon capture rates have been measured for carbon, oxygen and calcium targets. The carbon and oxygen rates yield large values for g_p when compared to detailed microscopic calculations but the conventional Goldberger-Treiman value when compared to phenomenological model calculations. A progress report on the TRIUMF RMC measurement on hydrogen is also given. 16 refs., 2 figs., 1 tab.

53762 **Proton propagation in nuclei studied in the *A* dependence of the (e,e'p) reaction in the quasifree region.** Geesaman,

D.F.; Gilman, R.; Green, M.C.; Holt, R.J.; Schiffer, J.P.; Zeidman, B.; Garino, G.; Saber, M.; Segel, R.E.; Beise, E.J.; and others. *Physical Review Letters (USA)*, 63(7): 734-737 (14 Aug 1989).

The *A* dependence of the $(e,e'p)$ reaction in the quasifree region has been measured at an average Q^2 of 0.33 $(GeV/c)^2$ for targets of ^{12}C, ^{27}Al, ^{58}Ni, and ^{181}Ta. The outgoing proton kinetic energy was 180±30 MeV. By comparing the ratio of $(e,e'p)$ coincidence to (e,e') singles yields, average proton transmissions are obtained for each target. The resulting "mean free path" or, more precisely, the attenuation length for protons in the nucleus is significantly longer than expectations based on the free nucleon-nucleon cross section.

53763 $^{12}C(\pi^{\pm},\pi^{\pm\prime}p)^{11}B$ reaction near the giant dipole region. Yoo, S.H. (University of Texas at Austin, Austin, Texas 78712-1081 (US)); Williams, A.; Mordechai, S.; Moore, C.F.; Morris, C.L.; Seestrom-Morris, S.J.; Jones, M.K.; Sterbenz, S.M.; Dehnhard, D.; Oakley, D.S.; and others. *Physical Review Letters (USA)*, 63(7): 738-741 (14 Aug 1989).

Cross sections for the $^{12}C(\pi^{\pm},\pi^{\pm\prime}p)^{11}B$ reaction have been measured and compared with the results of distorted-wave impulse-approximation calculations that employ the vactirozation approximation for quasifree scattering. Near the giant dipole resonance of ^{12}C the calculations underestimate the cross sections for $(\pi^-,\pi^{-\prime}p)$. The angular distributions for $(\pi^+,\pi^{+\prime}p)$ and $(\pi^-,\pi^{-\prime}p)$ are different and indicate that in this region there is interference between direct decay and semidirect decay.

53764 Properties of the giant dipole resonance built on the isobaric analog state. Mordechai, S. (Ben-Gurion University of the Negev, Beer-Sheva 84105, Israel (IL)); Auerbach, N.; Greene, S.; Morris, C.L.; O'Donnell, J.M.; Fortune, H.T.; Liu, G.; Burlein, M.; Wuosmaa, A.; Yoo, S.H.; and others. *Physical Review [Section] C: Nuclear Physics (USA)*, 40(2): 850-858 (Aug 1989).

Resonances were observed in pion-induced double charge exchange (at T_π=292 MeV) on ^{13}C, ^{59}Co, ^{93}Nb, ^{138}Ba, and ^{197}Au in the continuum at excitation energies of 8.4, 27.5, 33.2, 38.7, and 44.2 MeV, respectively (Q=−27.4, −32.3, −35.8, −38.4, and −46.0 MeV). An angular distribution was measured for the resonance on ^{93}Nb and observed to have a dipole shape. The measured cross sections and the angular distribution agree well with a simple sequential two-step calculation in which the intermediate states arise from single charge exchange to the isobaric analog state and to the giant dipole resonance. Based on their excitation energies, angular distribution for ^{93}Nb, and cross sections we identify the resonances as the giant dipoles built on the isobaric analog states. The new data together with the recent observation of the resonance in three other nuclei indicate that the excitation energies, widths, and cross sections for these resonances have a simple mass dependence.

6514 Nuclear Properties and Reactions, A=20-38, Experimental

Refer also to citation(s) 53762, 53784

53765 (INIS-mf–12006, pp. 73-74) **Spin and parity assignments to excited ^{37}Cl states.** Khan, S.; Kihm, T.; Knoepfle, K.T.; Mairle, G.; Reinhardt, H.; Seeger, M. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988*. Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

The $^{38}Ar(d,^3He)^{37}Cl$ reaction has been studied with polarized deuterons at 52 MeV incident energy. Spins and parities of excited ^{37}Cl states have been deduced from the measured angular distributions of differential cross sections and analyzing powers. (orig.).

53766 (INIS-mf–12006, pp. 78-80) **Polarized $^{6,7}Li$ scattering from ^{26}Mg at 44 MeV.** Rusek, K. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.)); Moroz, Z.; Ott, W.; Steffens, E.; Turkiewicz, I.M.; Vogt, H.; Becker, K.; Blatt, K.; Gerlach, A.; Korsch, W. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. In *Max-Planck-Institute for Nuclear Physics. Annual report 1988*. Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Elastic and inelastic scattering of polarized ^6Li from ^{26}Mg was measured. Coupled-channel calculations using cluster-folding potentials were performed. The method of coupled-channel was also used to study the mechanism of elastic and inelastic scattering of polarized ^7Li ions from the same target nucleus. (orig.).

53767 Inclusive production of K^+ mesons in 2.1-GeV/nucleon nuclear collisions. Schnetzer, S. (Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, Berkeley, California 94720 (US)); Lombard, R.M.; Lemaire, M.; Moeller, E.; Nagamiya, S.; Shapiro, G.; Steiner, H.; Tanihata, I. *Physical Review [Section] C: Nuclear Physics (USA)*, 40(2): 640-653 (Aug 1989). DOE Contract AC03-76SF00098.

K^+ meson production by 2.1-GeV/nucleon Ne, *d*, and *p* projectiles on NaF and Pb targets has been measured. The cross sections depend exponentially upon the kaon energy in the nucleon-nucleon c.m. frame, with an inverse slope T_0 larger than the values obtained from comparable proton and π^- spectra. The angular distribution in this frame is approximately isotropic. The *A* dependence of the kaon yield has been determined. Data are compared with theoretical predictions.

53768 Pion inelastic scattering to the low-lying broad 2^+ in ^{20}Ne. Burlein, M. (University of Pennsylvania, Philadelphia, Pennsylvania 19104 (US)); Fortune, H.T.; Amos, W.M.; Ekenberg, T.L.; Kotwal, A.; Kutt, P.H.; O'Donnell, J.M.; Silk, J.D.; Boyer, B.; Fuentes, A.; and others. *Physical Review [Section] C: Nuclear Physics (USA)*, 40(2): 785-789 (Aug 1989).

We have observed the broad 2^+ member of the $K^\pi=0_4^+$ band of ^{20}Ne with the $^{20}Ne(\pi^+,\pi^{+\prime})$ reaction at T_π=120 and 180 MeV and with $^{20}Ne(\pi^-,\pi^{-\prime})$ at T_π=180 MeV. We find an excitation energy of 9.00±0.18 MeV and a width of 0.8 MeV. The $B(E2\uparrow)$ is determined to be approximately 25 to 35 e^2fm^4.

53769 Comment on "Fragmentation of stretched spin strength in ^{29}Si". Geesaman, D.F. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439 (US)); Zeidman, B. *Physical Review Letters (USA)*, 63(8): 915-915 (21 Aug 1989). DOE Contract W-31-109-ENG-38.

A Comment on the Letter by Carr *et al.*, Phys. Rev. Lett. 62, 2249 (1989).

6515 Nuclear Properties and Reactions, A=39-58, Experimental

Refer also to citation(s) 53071, 53673, 53760, 53761, 53762, 53773

53770 (BNL–43282) **Effects of the hyperfine interactions on the decay of the collective nuclear excited states in α-hematite.** Faigel, G.; Berman, L.E.; Grover, J.R.; Hastings, J.B.; Haustein, P.E.; Siddons, D.P. Brookhaven National Lab., Upton, NY (USA). 1989. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890933–4: International conference on the applications of the Mossbauer effect (ICAME '89), Budapest (Hungary), 4-8 Sep 1989). Order Number DE90000767. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

In this paper the time dependence of the coherent decay of nuclear excited state in an α-$^{57}Fe_2O_3$ single crystal is presented. The experiment was carried out in diffraction geometry. A highly monocromatized and collimated beam of synchrotron radiation was used for the excitation of nuclear levels. Quantum beat spectra taken below and above the (7,7,7) pure nuclear reflection of hematite show a characteristic pattern corresponding to the magnetic and quadrupole hyperfine interactions. 16 refs., 1 fig.

53771 (INIS-mf–12006, pp. 65-67) **Investigation of monoenergetic pair conversion.** Kramp, J. (Heidelberg Univ. (Germany, F.R.). Physikalisches Inst.); Gerl, J.; Schwalm, D.; Habs, D.; Thirolf, P. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988*. Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Published in summary form only. ELECTRON-POSITRON INTERACTIONS/bhabha scattering; ELECTRON-POSITRON INTERACTIONS/annihilation; POSTULATED PARTICLES/electron-positron interactions; POSTULATED PARTICLES/internal pair

production; GAMMA DECAY/internal pair production; CHROMIUM 52/gamma decay; COBALT 59/gamma decay; BOSONS; RESONANCE; ANNIHILATION; POSITRONS; ELECTRONS; GAMMA SPECTRA; EXPERIMENTAL DATA; MEV RANGE 01-10; ENERGY SPECTRA; PHOTONS

53772 Isospin asymmetries in pion scattering to isoscalar giant quadrupole states in Ni isotopes. Oakley, D.S. (University of Colorado, Boulder, Colorado 80309 (US)); Braunstein, M.R.; Kraushaar, J.J.; Loveman, R.A.; Peterson, R.J.; Rilett, D.J.; Boudrie, R.L. *Physical Review [Section] C: Nuclear Physics (USA)*, 40(2): 859-864 (Aug 1989).

Inelastic scattering of 180 MeV π^- and π^+ from ^{58,60,62,64}Ni shows a prominent quadrupole feature near $65A^{-1/3}$ MeV, identified as the familiar isoscalar giant quadrupole resonance. For the heavier two isotopes, the π^- scattering cross sections greatly exceed those for π^+, the same effect previously noted in pion scattering on heavy nuclei. Since these four nickel targets contain a range of single-nucleon binding energies, these new data demonstrate the influence of these single-particle effects on the apparent isospin response, increasingly neutronlike for the heavier isotopes.

6516 Nuclear Properties and Reactions, A=59-89, Experimental

Refer also to citation(s) 53764, 53772

53773 (INIS-mf–12006, pp. 52-54) **Direct decay of giant resonances in medium-heavy nuclei.** Khan, S. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.)); Kihm, T.; Knoepfle, K.T.; Schulz, H.J.; Wen Chenlin; Friedrich, J.; Dolbilkin, B.S.; Kondratiev, R.L.; Lisin, V.P. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

(e,e'c) coincidence experiments at a momentum transfer of q=0.27 fm^{-1} reveal strong contributions of direct decay of the giant dipole resonance in ^{58,60}Ni and ^{64}Zn to proton hole states. Measurements at higher momentum transfers were combined with spectroscopic information from (d,^{3}He)-experiments to describe the coupling of E1 and E2/E0 excitations in ^{64}Zn to proton hole states quantitatively. (orig.).

53774 (INIS-mf–12006, pp. 74-75) **Lifetime measurement of compound nuclei via neutron-neutron correlations.** Gentner, R. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.)); Bellm, D.; Keller, K.; Lassen, L.; Luecking, W.; Marko, W.; Gemmeke, H. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

The investigation of correlations between identical particles evaporated from the deexcitation cascade of a compound nucleus offers the possibility to determine its lifetime. We measured nn-correlations in the system ^{18}O+^{64}Ni at 96 MeV bombarding energy. Fermions are expected to diminish the coincidence cross-section at small relative momenta due to the quantum statistical interference effect. The comparison of energy difference spectra at small and large relative angles shows, as expected, a reduction in the former case around ΔE=0. (orig.).

53775 Structure of odd-odd ^{74}Ga from the decay of neutron-rich ^{74}Zn. Winger, J.A. (Ames Laboratory, Iowa State University, Ames, Iowa 50011 (US)); Hill, J.C.; Wohn, F.K.; Brenner, D.S. *Physical Review [Section] C: Nuclear Physics (USA)*, 40(2): 1061-1064 (Aug 1989). DOE Contract W-7405-ENG-82.

A decay scheme of ^{74}Zn to levels in ^{74}Ga is presented in which 39 γ rays are placed, deexciting 11 states up to 1085 keV. Five levels are postulated to have J^π=1$^+$ based on β feedings but much uncertainty still exists concerning J^π assignments for levels below 300 keV.

6517 Nuclear Properties and Reactions, A=90-149, Experimental

Refer also to citation(s) 53092, 53764, 53790

53776 (DOE/ER/40418–2) **Radioactive decay and nuclear structure studies: Progress report, October 1, 1988–September 30, 1989.** Walters, W.B. Maryland Univ., College Park, MD (USA). Dept. of Chemistry and Biochemistry. [1989]. 105p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-88ER40418. Order Number DE90001397. Available from NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.

In this report, new results are reported for the nuclear structures of ^{119}Te, ^{121}Te, ^{120}Xe, ^{126}Xe, ^{127}Xe, ^{136}Xe, ^{129}Te, ^{145}La, and ^{147}Pr. Decay schemes are also given.

53777 (INIS-mf–12006, pp. 54-57) **Discrete and continuous γ-spectra from the decay of Dy compound nuclei.** Reiter, P. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.)); Thirolf, P.; Habs, D.; Gerl, J.; Schwalm, D.; Hennrich, H.J. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

The decay of highly excited Dy-compound nuclei has been studied with the Darmstadt-Heidelberg crystal ball spectrometer in the reaction ^{124}Sn(^{34}S,xn)$^{158-xn}$Dy at E_{lab}=150 MeV (E^*=69.2 MeV). The crystal ball was supplemented by four anti-Compton shielded germanium detectors and data were taken in coincidence with a newly developed annular parallel plate avalanche detector at extreme forward angles to identify the evaporation residues. The aim of the measurement was mainly to study the region of the 'statistical' γ-rays (E_γ=2-7 MeV), where earlier studies revealed significant discrepancies between the experimental data and model calculations within the framework of the Statistical Model. (orig.).

53778 (INIS-mf–12006, pp. 75-76) **Study of nuclear fragmentation in symmetric systems.** Pelte, D.; Gnirs, M. GSI-GANIL-Florence Collaboration. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

The cross sections for m_F=3,4,5 heavy fragment channels in the symmetric ^{100}Mo+^{100}Mo and ^{120}Sn+^{120}Sn reactions were measured at energies around 20 MeV/A. The energy and directional distributions of light evaporation products were analyzed in order to determine the contribution of different mechanisms to these reaction channels. (orig.).

53779 (IPEN-PUB–251) **Directional correlations of γ-transitions in ^{142}Ce.** Lapolli, A.L.; Zamboni, C.B.; Saxena, R.N. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Apr 1989. 23p. Order Number DE90606117. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Angular correlations of coincident gamma transitions have been measured in ^{142}Ce following the β^- decay of fission product ^{142}La ($T_{1/2}$ = 93 min) using a spectrometer consisting of a HPGe and a Ge(Li) detector. The measurements have been made on 14 direct and 13 skip cascades. Spin assignments were made to the levels at 2181 KeV (3+), 2727 KeV (1+), 3612 KeV (2+) and 4043 KeV (2+). In addition several previous spin assignments to other levels were confirmed. The multipole mixing ratios δ for 23 transitions were determined from the present results. (author).

53780 Nuclear data sheets for A=139. Burrows, T.W. (National Nuclear Data Center, Brookhaven National Laboratory, Upton, NY 11973 (US)). *Nuclear Data Sheets (USA)*, 57(3): 337-437 (Jul 1989). DOE Contract AC02-76CH00016.

The 1981 evaluation of A=139 (81Pe04) has been revised using experimental decay and reaction data received by April 17, 1989.

53781 Level structure of the odd mass Pr isotopes: Levels of ^{143}Pr$_{84}$ populated in the beta decay of ^{143}Ce. Kusnezov, D.F. (National Superconducting Cyclotron Laboratory, Department of Physics Astronomy, Michigan State University, East Lansing, Michigan 48824 (US)); Nethaway, D.R.; Meyer, R.A. *Physical Review*

[Section] C: Nuclear Physics (USA), 40(2): 924-931 (Aug 1989). DOE Contract W-7405-ENG-48.

We have studied the levels of ^{143}Pr populated in the beta decay of ^{143}Ce using singles and Compton suppression gamma-ray spectroscopy techniques. We determined a value of 33.10±0.05 h for the half-life of ^{143}Ce. In contrast to previous studies, we find no evidence for low-energy negative-parity levels in the decay of ^{143}Ce to ^{143}Pr. In addition we have performed calculations in the framework of the interacting boson-fermion model, which compare well with the level structure of ^{143}Pr. These calculations have been extended to the heavier Pr isotopes.

53782 Magnetic moment of the 2_1^+ state in ^{98}Sr. Wolf, A. (Brookhaven National Laboratory, Upton, New York 11973 (US)); Sistemich, K.; Mach, H.; Gill, R.L.; Casten, R.F.; Winger, J.A. *Physical Review [Section] C: Nuclear Physics (USA),* 40(2): 932-935 (Aug 1989). DOE Contract AC02-76CH00016.

The g factor of the 2_1^+ state in ^{98}Sr was measured by the perturbed angular correlation method at a fission product on-line separator. The result, g=0.38(7), is discussed in the framework of the proton-neutron interacting boson approximation and in relation to $g(2_1^+)$ values for two other N=60 isotones, ^{100}Zr and ^{102}Mo.

6518 Nuclear Properties and Reactions, A=150-189, Experimental

Refer also to citation(s) 53762

53783 (INIS-mf–12006, pp. 64) **Investigation of high spin states in ^{154}Er.** Fluegel, M. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.)); Piepke, A.; Stamopoulos, C.; Strecker, H.; Klapdor, H.V.; Mansour, N.; Osuch, S.; Szeflinska, G.; Szeflinski, Z. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

High-spin states in ^{154}Er were investigated by the reaction ^{92}Zr(^{64}Ni,2n)^{154}Er at E_{Lab}=239 MeV. A resolved superdeformed band could not be observed in our spectra. (orig./HSI).

53784 (INIS-mf–12006, pp. 103-106) **Nuclear collisions at 200 GeV/u (HELIOS/NA34 experiment).** Bartels, H.W.; Drees, A.; Glaessel, P.; Hoelscher, A.; Kroh, V.; Neubert, M.; Pfeiffer, A.; Specht, H.J. Bari-Brookhaven-Brussels-CERN-Copenhagen-Heidelberg-Los Alamos-Lund-Montreal-Moscow-Novosibirsk-Oxford-Pittsburgh-Rome-Didcot-Saclay-Salermo-Stockholm-Tel Aviv-Turin-London-Rehovot-Vienna Collaboration. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Results of the analysis of data from the HELIOS experiment at CERN are reported. Data of protons, ^{16}O and ^{32}S on various nuclear targets at 200 GeV/u, and 450 GeV/c proton data have been recorded. Individual charged particle and photon data were measured with a magnetic spectrometer in the rapidity region 0.9<eta<1.9. The systematics of the p_T-spectra is discussed. Photons near mid-rapidity recorded with a BGO-matrix exhibit an unexplained excess above the rates expected for hadronic decays and bremsstrahlung in the region p_T<30 MeV/c. (orig.).

53785 Neutron scattering in ^{189}Os for nucleosynthesis rates of the odd-A Os isotopes and nucleochronology. McEllistrem, M.T. (Department of Physics and Astronomy, University of Kentucky, Lexington, Kentucky 40506 (US)); Winters, R.R.; Hershberger, R.L.; Cao, Z.; Macklin, R.L.; Hill, N.W. *Physical Review [Section] C: Nuclear Physics (USA),* 40(2): 591-600 (Aug 1989).

Neutron elastic and inelastic scattering cross sections have been determined for neutrons incident on ^{189}Os at three very low energies. Cross sections for scattering to the ground state and 36.2-keV excited level have been measured for incident energies of 63.5 and 73.3 keV, and also to the 69.6-keV excited level at 97.5-keV incident energy. These measurements are combined with neutron scattering cross sections for ^{187}Os, neutron capture cross sections, and other low-energy scattering observables to provide a basis for a single, consistent model of all data for both odd-A Os isotopes. The properly interpreted capture rates are important for the Re/Os nucleochronology and for s-process nucleosynthesis rates. The elastic and inelastic scattering cross sections provide a very-low-energy test of statistical model-flux distributions; model accuracy at very low energies is an important issue for reaction rates used in nucleosynthesis estimates.

53786 Neutron emission from products of strongly damped reactions ^{58}Ni+^{165}Ho at 930 MeV. Petitt, G.A. (Georgia State University, Atlanta, Georgia 30303 (US)); Butler, C.; Penumetcha, V.; Awes, T.C.; Beene, J.R.; Ferguson, R.L.; Obenshain, F.E.; Plasil, F.; Young, G.R.; Sorensen, S.P.; and others. *Physical Review [Section] C: Nuclear Physics (USA),* 40(2): 692-705 (Aug 1989). DOE Contract AC05-84OR21400.

Neutron time-of-flight spectra have been measured for emission from products of reactions between ^{58}Ni and ^{165}Ho at a bombarding energy of 930 MeV. Neutrons were detected in coincidence with projectilelike fragments from strongly damped reactions using a heavy ion ΔE-E telescope which permitted the total kinetic energy loss to be extracted for each event. The neutron spectra were separated into 25-MeV-wide total kinetic energy loss bins over the total kinetic energy loss range from 0 to 450 MeV. Moving source fits were made to the neutron spectra to determine emission temperatures, multiplicities, velocities, and angles for the projectilelike fragment, targetlike fragment, and nonequilibrium emission sources as a function of the total kinetic energy loss. The extracted temperature of the projectlike fragment is found to be larger than that of the targetlike fragment source at all total kinetic energy losses, approaching that of the targetlike fragment only at the largest total kinetic energy losses. The results suggest an equal division of the available excitation energy at small total kinetic energy loss with a thermal energy division occurring only at the largest total kinetic energy losses. The velocity of the nonequilibrium source is found to remain constant at approximately one-half of the beam velocity independent of the final projectlike fragment velocity. This result supports models of nonequilibrium emission in which nucleon emission is isotropic in the nucleon-nucleon center-of-mass system as opposed to models in which the nonequilibrium emission occurs isotropically from the heavy fragments along their reaction trajectories.

53787 High-spin studies of ^{172,173}Os: Complex alignment mechanism. Wells, J.C. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831 (US)); Johnson, N.R.; Baktash, C.; Lee, I.Y.; McGowan, F.K.; Riley, M.A.; Virtanen, A.; Dudek, J. *Physical Review [Section] C: Nuclear Physics (USA),* 40(2): 725-741 (Aug 1989). DOE Contract AC05-84OR21400.

High-spin states of ^{172}Os have been investigated by γ-γ coincidence studies. These states were populated by the ^{144}Nd(^{32}S,4n) reaction using 162-MeV ^{32}S ions. Gamma-gamma coincidence measurements were made with a Compton-suppression spectrometer system. The yrast band was observed up through the 30$^+$ state, and four sidebands were deduced from γ-γ coincidence relationships. A band identified as belonging to ^{173}Os was also observed. Results were interpreted using average nuclear field calculations which incorporated the deformed Woods-Saxon potential with its "universal" parametrization, a cranking approximation, and the Hartree-Fock-Bogoliubov method. The calculations indicate the presence of strongly interacting quasiparticle band crossings for 0.2<$\hbar\omega$<0.3, in semiquantitative agreement with experiment. Both the quasiparticle band structures and decline of neutron pairing are discussed.

53788 Exotic N=82 nuclei ^{153}Lu and ^{154}Hf and filling of the $\pi h_{11/2}$ subshell. McNeill, J.H. (Department of Physics, Schuster Laboratory, University of Manchester, Manchester M139PL, United Kingdom (GB)); Blomqvist, J.; Chishti, A.A.; Daly, P.J.; Gelletly, W.; Hotchkis, M.A.C.; Piiparinen, M.; Varley, B.J.; Woods, P.J. *Physical Review Letters (USA),* 63(8): 860-863 (21 Aug 1989).

Microsecond isomers in the very proton-rich N=82 nuclei ^{153}Lu and ^{154}Hf have been identified by γ-ray spectroscopy following mass analysis of ^{102}Pd +245 MeV ^{54}Fe reaction products using the Daresbury Recoil Separator. The decays of the isomers, interpreted as $(\pi h_{11/2})^n$ states, are characterized. Examination of reduced $E2$ transition rates between $(\pi h_{11/2})^n$ states in the N=82 isotones indicates that the half-filling of the $\pi h_{11/2}$ subshell occurs just below Z=71.

6519 Nuclear Properties and Reactions, A=190-219, Experimental

Refer also to citation(s) 53764, 53767, 53794

53789 (CENBG–88-27) **Two-proton interferometry at backward angles in ^{16}O + ^{197}Au at E/A = 94 MeV.** Lautridou, P.; Quebert, J.; Lebrun, C.; Guilbault, F.; Goujdami, D.; Durand, D.; Ardouin, D.; Peghaire, A.; Saint-Laurent, F. Bordeaux-1 Univ., 33 - Gradignan (France). Centre d'Etudes Nucleaires. 1988. 13p. Order Number DE90713778. Available from NTIS (US Sales Only), PC A03/MF A01.

Backward angle measurements of the p-p correlation function at small relative momenta exhibit a damping of final state interactions. This new shape is analysed in the framework of Fermi-Dirac statistical effects for which a characteristic lifetime of the order of 10^{-21}s is deduced.

53790 (DOE/ER/40330–34) **Nuclear structure from radioactive decay: Annual progress report.** Wood, J.L. Georgia Inst. of Tech., Atlanta, GA (USA). School of Physics. 30 Sep 1989. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-87ER40330. Order Number DE90001229. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A program has been initiated to systematically study the structure of the very neutron-deficient nuclei in and near the region of deformation with Z > 50, N < 82. This has necessitated ion-source development. Radioactive decay is the only way to observe low-spin states in this region. Only with such information will details of the nuclear shape and nuclear stability in this new region of deformation be understood. This report discusses work done in this Z region.

53791 (INIS-mf–12006, pp. 47-48) **Forward-backward asymmetry at direct break-up of ^{6}Li.** Hesselbarth, J.; Khan, S.; Kihm, T.; Knoepfle, K.T. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

The (α+d) breakup of 60 MeV ^{6}Li scattered from ^{208}Pb has been measured inside the grazing angle for c.m. energies of the fragments between 100 keV and 1.5 MeV. The distinctly different anisotropies of the sequential and direct breakup components show that Coulomb dissociation cannot be related in a straightforward manner to the astrophysically relevant $^{4}He(d,\gamma)^{6}Li$ capture reaction. (orig.).

53792 **Observation of superdeformation in ^{191}Hg.** Moore, E.F. (Argonne National Laboratory, Argonne, Illinois 60439 (US)); Janssens, R.V.F.; Chasman, R.R.; Ahmad, I.; Khoo, T.L.; Wolfs, F.L.H.; Ye, D.; Beard, K.B.; Garg, U.; Drigert, M.W.; and others. *Physical Review Letters (USA),* 63(4): 360-363 (24 Jul 1989). DOE Contract W-31-109-ENG-38;AC07-76ID01570;FG02-87ER40346.

The first observation of superdeformation in the mass region $A \cong 190$ is reported. A rotational band of twelve transitions with an average energy spacing of 37 keV, an average moment of inertia $\mathcal{J}^{(2)}$ of 110 $\hbar^2$ MeV^{-1}, and an average quadrupole moment of 18±3 e b has been observed in ^{191}Hg; this band persists at low rotational frequency. These results are in excellent agreement with a calculation that predicts an ellipsoidal axis ratio of 1.65:1 for the superdeformed shape in this nucleus.

6520 Nuclear Properties and Reactions, A=220 and Above, Experimental

Refer also to citation(s) 53782

53793 (INIS-mf–12006, pp. 67-72) **Investigation of shape isomeric states in actinides.** Schirmer, J. (Heidelberg Univ. (Germany, F.R.). Physikalisches Inst.); Gerl, J.; Schwalm, D.; Theis, C.; Habs, D. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

The γ-decay of the ^{236}U shape isomer at E_{II}=(2.75+-0.01) MeV has been observed, as reported last year. The ratio of γ-decay to delayed fission - the competing process - has been determined to $\Gamma_{F\gamma}/\Gamma_{FI}$=8+-3. Four different cascades depopulating the shape isomer are found and investigated in detail. With regard to that, the excitation function and the γ-γ angular correlation are discussed. With the same method it is also possible to search for other shape isomers, e.g. in the thorium isotopes. First results in a $^{232}Th(d,p)^{233}Th$ experiment show an isomeric state with an excitation energy of E_{II}=2.8 MeV and a halflive of $t_{1/2}$=17 ns, which might be a good candidate for a shape isomer in ^{233}Th. (orig.).

53794 (INIS-mf–12006, pp. 72) **Spectroscopic investigation of the neutron-deficient ^{220}Th.** Heller, F. (Heidelberg Univ. (Germany, F.R.). Physikalisches Inst.); Gerl, J.; Schwalm, D.; Habs, D.; Schwartz, B. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Our investigation of the light octupole deformed Th isotopes has been continued with a new measurement of high spin states in ^{220}Th. The aim of this experiment is to extend the yrast band to higher spins and to search for a s=-1 sequence. (orig.).

53795 (INIS-mf–12006, pp. 72-73) **Search for many-phonon excitations in ^{232}Th.** Korten, W. (Heidelberg Univ. (Germany, F.R.). Physikalisches Inst.); Gerl, J.; Schwalm, D.; Habs, D. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

The investigation of side bands in ^{232}Th, performed by a Coulomb excitation experiment with 396 MeV ^{90}Zr-projectiles was completed. Thereby a new band with a band-head at 1414 keV was discovered. We propose this band to be the two phonon $\gamma\gamma$-band. To prove the spin assignment of the 1414 keV state unambiguously, a new particle-γ correlation measurement has been performed. (orig.).

53796 (INIS-mf–12006, pp. 80-82) **Investigation of inelastic scattering and transfer reactions at the system ^{18}O -> ^{232}Th by the crystal ball.** Klein, H. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.)); Habs, D.; Heyng, H.W.; Gerl, J.; Ender, C.; Korten, W.; Schwalm, D. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Transfer reactions and inelastic scattering around the Coulomb barrier has been studied in the system ^{18}O->^{232}Th. Impact parameter dependent form factors have been determined for several neutron transfer channels. The pick-up channels show the expected increase of the form factor slope with increasing number of transfered neutrons, whereas the slope of the 2n pick-up channel appears to be to flat. The inelastic channel reveals a strong enhancement of collective vibrational states in ^{232}Th. Especially the two phonon $\gamma\gamma$ bandhead has five times the intensity of what is expected from pure Coulomb excitation. (orig.).

53797 (INIS-SU–119/A, pp. 99-103) **Cross section of ^{236}Np fission by 10 keV neutrons.** Val'skij, G.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii); Gromova, E.A.; Danichev, V.V. and others. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev (USSR), 14-18 Sep 1987). In *Neutron physics. V. 3.* Order Number DE90705913. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

T-12589.

A procedure for obtaining ^{236}Np is described and results of measuring the fission cross section of ^{236}Np in a long-lived state by monochromatic neutrons, as well as by neutrons of a nonstationary moderation spectrum in Pb are given. 8 refs.; 1 fig.; 2 tabs.

53798 (INIS-SU–119/A, pp. 98) **Constants of delayed neutrons.** Manevich, L.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii); Nemirovskij, P.Eh.; Yudkevich, M.S. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev (USSR), 14-18 Sep 1987). In *Neutron physics. V. 3.* Order Number DE90705913. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

T-12589.

Short note. PLUTONIUM 239 TARGET/thermal fission; PLUTONIUM 241 TARGET/thermal fission; URANIUM 235 TARGET/thermal fission; URANIUM 238 TARGET/thermal fission; DELAYED NEUTRON PRECURSORS; DELAYED NEUTRONS; GROUP CONSTANTS

53799 (INIS-SU–119/A, pp. 92-98) **Experimental study of ^{232}Th fission cross sections by neutrons with 0.55-0.87 MeV energy.** Shpak, D.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.); Korolev, G.G.; Androsenko, Kh.D. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev (USSR), 14-18 Sep 1987). In *Neutron physics. V. 3.* Order Number DE90705913. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

T-12589.

The results of cross section measurements in thorium-232 (n,f)-reaction, which verifies the availabilities of deep-subbarrier feature (plateau) in its dependence at the neutron energy below 0.7 MeV. Interpretation of the observed effect within existent representations is hindered. 24 refs.; 3 figs.

53800 (INIS-SU–119/A, pp. 89-91) **Absolute measurements of ^{242m}Am fission cross sections by ^{252}Cf spontaneous fission spectrum neutrons.** Gusev, S.E. (Radievyj Inst., Leningrad (USSR)); Drapchinskij, L.V.; Dushin, V.N.; Kovalenko, S.S.; Kol'tsov, V.V.; Kostochkin, O.I.; Soloshenkov, P.S.; Trenkin, V.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev (USSR), 14-18 Sep 1987). In *Neutron physics. V. 3.* Order Number DE90705913. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

T-12589.

The absolute measurement of ^{242m}Am fission cross section by ^{252}Cf fission spectrum neutrons has been carried out using the method of coincidence between ^{252}Cf spontaneous fission and ^{242m}Am induced fission. The fission cross section value was found to be 1.60+-0.22 b. 5 refs.

53801 (INIS-SU–119/A, pp. 84-88) **Measurement of transuranium element fission cross section on spectrometer of delayed neutrons in lead.** Gerasimov, V.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii); Danichev, V.V.; Dement'ev, V.N.; Zenkevich, V.S.; Mozolev, G.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev (USSR), 14-18 Sep 1987). In *Neutron physics. V. 3.* Order Number DE90705913. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

T-12589.

The solution of an inverse problem of spectroscopy allows average fission cross sections to be obtained on the spectrometer of delayed neutrons in Pb with the accuracy of no worse than 3%. 26-group fission cross sections of ^{239,241}Pu, ^{242m}Am, ^{245}Cm by neutrons with the energy of 4.65 eV - 21.5 keV are presented. 14 refs.; 2 tabs.

53802 (INIS-SU–119/A, pp. 83) **Measurement of ^{236}U and ^{235}U fission cross section ratio in the neutron energy range of 0.5-3.72 MeV.** Shpak, D.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.); Korolev, G.G.; Androsenko, Kh.D. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev (USSR), 14-18 Sep 1987). In *Neutron physics. V. 3.* Order Number DE90705913. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

T-12589.

Short note. NEUTRON REACTIONS/fission; URANIUM 235 TARGET/neutron reactions; URANIUM 236 TARGET/neutron reactions; CROSS SECTIONS; KEV RANGE 100-1000; MEV RANGE 01-10; FISSION

53803 (INIS-SU–119/A, pp. 76-79) **^{236}Pu neutron-induced fission cross section.** Vorotnikov, P.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii); Gokhberg, B.M.; Gromova, E.A.; Kovalenko, S.S.; Selitskij, Yu.A.; Fridkin, A.M.; Funshtejn, V.B.; Yakovlev, V.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev (USSR), 14-18 Sep 1987). In *Neutron physics. V. 3.* Order Number DE90705913. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

T-12589.

The Pu-236 neutron induced fission cross sections were measured relative to Pu-239 fission cross sections in the energy range 0.006-6 MeV. Epicadmium resonance ^{236}Pu fission integral was measured. The electrostatic accelerators and reactor VVR-M were used. 10 refs.

53804 (INIS-SU–119/A, pp. 68-75) **Energy and angular distribution of neutron emission in the spontaneous fission of ^{252}Cf.** Murten, N. (Technische Univ., Dresden (German Democratic Republic)); Richter, D.; Seeliger, D.; Heubert, W.; Lajtai, A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1988. (CONF-870959–: 1. international conference on neutron physics, Kiev (USSR), 14-18 Sep 1987). In *Neutron physics. V. 3.* Order Number DE90705913. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

T-12589.

A new expermental method has been applied to measure the double-differential emission probability of Cf fission neutrons between 100 keV and 10 MeV. The neutron-fragment correlation experiment has been based on neutron time-of-flight spectroscopy combined with a direction-sensitive method of fragment spectroscopy. The angular distributions obtained cover the whole range

from 0 to π^-. Results are presented and discussed in comparison with previous data. 10 refs.; 6 figs.; 1 tab.

53805 (INIS-SU–119/A, pp. 40-43) **Absolute energy of ^{230}Th subthreshold fission resonance near 715 keV.** Walsh, R.L. (Australian Atomic Energy Commission Research Establishment, Lucas Heights (Australia)); Boldeman, J.W. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1988. (CONF-870959–: 1. international conference on neutron physics, Kiev (USSR), 14-18 Sep 1987). In *Neutron physics. V. 3.* Order Number DE90705913. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.
T-12589.

The relative neutron fission cross section of ^{230}Th near the 715 keV subthreshold resonance has been measured using a Van de Graaf accelerator. The purpose was to investigate discrepancies of 5 to 7 keV in absolute energy that exist in the results of various authors. The absolute energy of the data of Blons et al. 10 refs.; 3 figs.; 1 tab.

53806 (INIS-SU–119/A, pp. 3-15) **Spontaneous decay of heavy nuclei with emission of light nuclei.** Zamyatin, Yu.S. (Joint Inst. for Nuclear Research, Dubna (USSR)). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev (USSR), 14-18 Sep 1987). In *Neutron physics. V. 3.* Order Number DE90705913. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.
T-12589.

The review is given of the experimental works on the dicovery of heavy nuclei spontaneous decay by the emission of clusters heavier than ^{4}He. Prospects of further investigations of this process are discussed. 31 refs.; 2 figs.; 3 tabs.

53807 (INIS-SU–119/A, pp. 127-130) **Character of ν-bar$_p$ dependence on excitation energy and spins of fissile nuclei.** Serov, V.I.; Andreev, M.F. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev (USSR), 14-18 Sep 1987). In *Neutron physics. V. 3.* Order Number DE90705913. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.
T-12589.

The empirical dependence of ν-bar$_p$ with physical parameters from excitation energy under actinide nuclei fission is considered. 7 refs.; 2 figs.

53808 (INIS-SU–119/A, pp. 122-126) **Determination of the cross sections of delayed neutron production at microtron M-30.** Ganich, P.P. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij); Lendel, A.I.; Marinets, T.I.; Parlag, O.A.; Sikora, D.I.; Sychev, S.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev (USSR), 14-18 Sep 1987). In *Neutron physics. V. 3.* Order Number DE90705913. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.
T-12589.

The cross sections of delayed neutron formation are determined at the fission of ^{232}Th, ^{235,238}U, ^{237}Np and ^{239}Pu by gamma-quanta of bremsstrahlung in the range of El giant resonance. The resulting data are explained by systematics of total absolute yields of delayed neutrons and the model of five-Gausse mass distributions of fission products. 8 refs.; 4 figs.

53809 (INIS-SU–119/A, pp. 118-121) **Present status of delayed neutron investigations. Justification of choice of systematization parameters of delayed neutron total absolute yields.** Sikora, D.I. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev (USSR), 14-18 Sep 1987). In *Neutron physics. V. 3.* Order Number DE90705913. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.
T-12589.

The principal results of the delayed neutron investigations are considered. A sistematization of delayed neutron total absolute yields over the parameter depending on the compound nuclei excitation energy is proposed. 14 refs.

53810 (INIS-SU–119/A, pp. 117) **Fission yield in odd nuclei fission by neutrons.** Teplykh, V.F. (Leningradskij Tekhnologicheskij Inst., Leningrad (USSR)); Platygina, E.V.; Petrak, K.A.; Solonkin, A.A.; Frolov, S.V.; Nebogatikov, V.B. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev (USSR), 14-18 Sep 1987). In *Neutron physics. V. 3.* Order Number DE90705913. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.
T-12589.

Short note. AMERICIUM ISOTOPES/fission; FISSION/fission yield; NEPTUNIUM ISOTOPES/fission; FISSION; EVEN-ODD NUCLEI; MASS SPECTROSCOPY; NEUTRON REACTIONS; ODD-EVEN NUCLEI

53811 (INIS-SU–119/A, pp. 108-112) **Comparison of evaluations of ^{252}Cf spontaneous shape fission prompt neutron spectrum.** Bojtsov, A.A. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)); Starostov, B.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev (USSR), 14-18 Sep 1987). In *Neutron physics. V. 3.* Order Number DE90705913. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.
T-12589.

The comparison of evaluations of prompt neutron spectrum of ^{252}Cf fission obtained by independent research groups is presented. It is shown that in the energy interval of 0.001-20 MeV the results can be agreed within the range of +- 2 %. 9 refs.; 4 tabs.

53812 (INIS-SU–119/A, pp. 104-107) **Prompt neutron spectra of ^{233}U, ^{235}U, ^{239}Pu, ^{252}Cf fission in the energy range of 0.01-12 MeV.** Bojtsov, A.A. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)); Nefedov, V.N.; Starostov, B.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR,

Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1988. (In Russian). (CONF-870959--: 1. international conference on neutron physics, Kiev (USSR), 14-18 Sep 1987). In *Neutron physics. V. 3.* Order Number DE90705913. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

T-12589.

The time-of-flight method has been used for measurements of prompt neutron spectra of ^{233}U, ^{235}U, ^{239}Pu fission by thermal neutrons and of ^{252}Cf spontaneous fission in the energy interval of 0.01-12 MeV. In the interval of 0.01-6 MeV the spectra are described by the distributions of Maxwell type within the limits of +- 5%. With the energy above 6 MeV the spectra intensities are less than those of Maxwell distributions. 2 refs.; 2 figs.

53813 (INIS-SU-119/A, pp. 103) **Absolute measurements of ^{233}U, ^{235}U, ^{237}Np fission cross sections by 1.9 and 2.4 MeV neutrons by the method of time correlated associated particles.** Kalinin, V.A. (Radievyj Inst., Leningrad (USSR)); Kovalenko, S.S.; Kuz'min, V.N.; Nemilov, Yu.A.; Solin, L.M.; Shpakov, V.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1988. (In Russian). (CONF-870959--: 1. international conference on neutron physics, Kiev (USSR), 14-18 Sep 1987). In *Neutron physics. V. 3.* Order Number DE90705913. Available from NTIS (US Sales Only), PC A17/MF A01 - OSTI; INIS.

T-12589.

Short note. NEPTUNIUM 237 TARGET/neutron reactions; NEUTRON REACTIONS/fission; URANIUM 233 TARGET/neutron reactions; URANIUM 235 TARGET/neutron reactions; CROSS SECTIONS; MEV RANGE 01-10; FISSION

53814 (INIS-SU-119/A, pp. 281-284) **Absolute cross section of the $^{238}U(n,2n)$ reaction at neutron energy of 14.76 MeV.** Golovnya, V.Ya. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.); Goncharov, K.S.; Dolya, G.P.; Kuz'menko, V.A.; Pasechnik, S.G.; Remaev, V.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1988. (In Russian). (CONF-870959--: 1. international conference on neutron physics, Kiev (USSR), 14-18 Sep 1987). In *Neutron physics. V. 3.* Order Number DE90705913. Available from NTIS (US Sales Only), PC A16/MF A01 - OSTI; INIS.

T-12589.

The cross section of the reaction ^{238}U (n, 2n) ^{237}U has been measured at E_n=14.76 MeV. The measured cross section is σ (n,2n)=(0.705+0.026)b - (0.705-0.031)b using the reference cross section of the reaction $^{169}Tm(n,2n)^{168}Tm$, σ_0=(1.98+-0.04)b. 4 refs.; 2 tabs.

53815 (INIS-SU-119/A, pp. 277-280) **Cross section of the $^{238}U(n, 2n)^{237}U$ reaction induced by neutrons of ^{252}Cf spontaneous fission.** Blinov, M.V. (Radievyj Inst., Leningrad (USSR)); Gromova, E.A.; Kovalenko, S.S.; Stsiborskij, B.D.; Chuvaev, S.V.; Shiryaev, B.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1988. (In Russian). (CONF-870959--: 1. international conference on neutron physics, Kiev (USSR), 14-18 Sep 1987). In *Neutron physics. V. 3.* Order Number DE90705913. Available from NTIS (US Sales Only), PC A16/MF A01 - OSTI; INIS.

T-12589.

The cross section of the $^{238}U(n,2n)^{237}U$ reaction induced by ^{252}Cf spontaneous fission neutrons has been measured by activation method. γ-raiation of ^{237}U accumulated in the ^{235}U samples was used.

53816 (INIS-SU-119/A, pp. 260-270) **Revised results of absolute $^{239}Pu(n,f)$ measurements at 4.9 MeV, 8.654 MeV, 14.7 MeV and 18.8 MeV neutron energy.** Herbach, C.M. (Technische Univ., Dresden (German Democratic Republic)); Merla, K.; Musiol, G. and others. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1988. (CONF-870959--: 1. international conference on neutron physics, Kiev (USSR), 14-18 Sep 1987). In *Neutron physics. V. 3.* Order Number DE90705913. Available from NTIS (US Sales Only), PC A16/MF A01 - OSTI; INIS.

T-12589.

Absolute measurement of the ^{239}Pu fast fission cross-section have been carried out at a neutron generator of the TU Dresden and at the tandem van-de-Graaf accelerator of the CINR Rossendorf (GDR) in 1977-1985, using the Time-Correlated Asasociated Particles Method (TCAPM) at selected neutron energy spot points. Experimental investigations at the OuF_4 fission foils led to absorpotion correctrions of the several samples, which are 2.7-4.7% higher than assumed earlier. Consequently, the correction of the preliminary data results in higher $^{239}Pu(n,f)$-values. Following the presented measurements, a revision of the current files is indicated within the covered neutron energy range. 40 refs.; 10 figs.; 2 tabs.

53817 (INIS-SU-119/A, pp. 248-259) **Absolute measurements of the U-238 fission cross section at 4.8 MeV, 8.4 MeV and 18.8 MeV neutron energies using the TCAM.** Merla, K. (Technische Univ., Dresden (German Democratic Republic)); Herbach, S.M.; Musiol, G. and others. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1988. (CONF-870959--: 1. international conference on neutron physics, Kiev (USSR), 14-18 Sep 1987). In *Neutron physics. V. 3.* Order Number DE90705913. Available from NTIS (US Sales Only), PC A16/MF A01 - OSTI; INIS.

T-12589.

Experimental details and preliminary results of absolute measurements, carried out at the CINR Rossendorf by the TU Dresden/RI Leningrad cooperation are reviewed. Using the Time-Correlated Associated Particle Method (TCAPM), uncertainties of 1.8% and 2.9% were obtained at 8.4 MeV and 18.8 MeV neutron energies, respectively. Because of progresses in the experimental technique, the properties of the fission deposits became the restrictive factor of the experimental accuracy in these measurements. A first short run with poor statistics at 4.8 MeV resulted in a standard deviation of 2.8% for the U-238 (n,f) cross section. 22 refs.; 6 figs.; 2 tabs.

53818 (INIS-SU-119/A, pp. 371) **Change of the absolute cross section of the U(n, ^{8}Be) reaction at the neutron energy of 14.7 MeV.** Rutkevich, N.Ya. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.); Golovnya, V.Ya.; Olejnik, S.N.; Sheptulenko, E.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1988. (In Russian). (CONF-870959--: 1. international conference on neutron physics, Kiev (USSR), 14-18 Sep 1987). In *Neutron physics. V. 3.* Order Number DE90705913. Available from NTIS (US Sales Only), PC A16/MF A01 - OSTI; INIS.

T-12589.

Short note. URANIUM/neutron reactions; BERYLLIUM 8; CROSS SECTIONS; MEV RANGE 10-100; URANIUM

53819 (UCRL–101613) **Some neutron and photon reactions on the ground and isomeric states of ^{236,237}Np.** Gardner, D.G.; Gardner, M.A. Lawrence Livermore National Lab., CA (USA). 11 Sep 1989. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890982–3: International meeting on neutron activation cross section for fission and fusion energy applications, Argonne, IL (USA), 11-15 Sep 1989). Order Number DE90001508. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We present results of calculated neutron- and photon-induced reactions on the 1.1 × 10^5–y ground state and 22.5-h isomer of ^{236}Np and on the 2.1 × 10^6–y ground state and 68-ns isomer of ^{237}Np. Of primary concern are the isomeric ratios produced although some photon absorption and photoneutron results are given. We discuss the production of the short-lived isomer of ^{236}Np, via the (n,2n) and (γ,n) reactions on ^{237}Np, leading eventually to the high-energy γ-ray emitter, ^{208}Pb; the photoproduction and destruction of the 60-keV, 68-ns isomer of ^{237}Np, a possible gamma-ray laser candidate; and the use of photoexcitation and destruction of nuclear isomers in the field of nuclear waste disposal. The effect of the choice of the physics parameters on the calculated results is also illustrated. 14 figs., 2 tabs.

53820 Spontaneous fission properties of ^{258}Fm, ^{259}Md, ^{260}Md, ^{258}No, and ^{260}[104]: Bimodal fission. Hulet, E.K. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94551 (US)); Wild, J.F.; Dougan, R.J.; Lougheed, R.W.; Landrum, J.H.; Dougan, A.D.; Baisden, P.A.; Henderson, C.M.; Dupzyk, R.J.; Hahn, R.L.; and others. *Physical Review [Section] C: Nuclear Physics (USA)*, 40(2): 770-784 (Aug 1989). DOE Contract W-7405-ENG-48.

We have measured the mass and kinetic-energy distributions from the spontaneous fission of ^{258}Fm, ^{258}No, ^{259}Md, ^{260}Md, and ^{260}[104]. All are observed to fission with a symmetrical division of mass. The total-kinetic-energy distributions strongly deviated from the Gaussian shape characteristically found in the fission of all other actinides. When the total-kinetic-energy distributions are resolved into two Gaussians, the constituent peaks lie near 200 and 233 MeV. We conclude that both low- and high-energy fission modes occur in four of the five nuclides studied. We call this property "bimodal fission." Even though both modes are possible in the same nuclide, one generally predominates. We offer an explanation for each mode based on shell structures of the fissioning nucleus and of its fragments. The appearance of both modes of fission in this region of the nuclide chart seems to be a coincidence in that the opportunity to divide into near doubly magic Sn fragments occurs in the same region where the second fission barrier is expected to drop in energy below the ground state of the fissioning nucleus. Appropriate paths on the potential-energy surface of deformation have been found by theorists, but no physical grounds have been advanced that would allow the near equal populations we observe traveling each path. We suggest that this failure to find a reason for somewhat equal branching may be a fundamental flaw of current fission models. Assuming the proposed origins of these modes are correct, we conclude the low-energy, but also mass-symmetrical mode is likely to extend to far heavier nuclei. The high-energy mode will be restricted to a smaller region, a realm of nuclei defined by the proximity of the fragments to the strong neutron and proton shells in ^{132}Sn.

6530 Nuclear Theory

Refer also to citation(s) 51995, 52236, 52407, 53677, 53745, 53754, 53757, 53758, 53766, 53772, 53787, 53820

53821 (CENBG–88-26) **Macroscopic model description of heavy-ion induced complex-fragment emission.** Carjan, N. Bordeaux-1 Univ., 33 - Gradignan (France). Centre d'Etudes Nucleaires. 1988. 17p. (CONF-880896–: JAERI international symposium on heavy-ion reaction dynamics in tandem energy region, Hitachi (Japan), 1-3 Aug 1988). Order Number DE90713768. Available from NTIS (US Sales Only), PC A03/MF A01.

The Yukawa-plus-exponential finite-range model and the standard liquid-drop model are shortly reviewed and compared. The dependence of the barrier heights and of the saddle-point shapes on mass-asymmetry and on angular momentum is studied for the compound nuclei ^{110}Sn, ^{149}Tb and ^{194}Hg. The predicted asymmetric-fission barriers, charge yields and total kinetic energies are compared with experimental data obtained from the deexcitation of compound nuclei by complex-fragment emission.

53822 (DOE/ER/40425–244) **Nuclear structure theory: Technical progress report, September 1, 1988–August 31, 1989.** French, J.B.; Koltun, D.S. Rochester Univ., NY (USA). [1989]. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-88ER40425. (UR–1121). Order Number DE90001670. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This report summarizes progress during the past year in the following areas of research: Pion charge exchange reactions, including a theory of the contribution of pion absorption and correlated double scattering to double charge exchange, new coupled channel calculations for single and double charge exchange from ^{14}C. Nuclear inelastic scattering, using quark models to calculate nuclear structure functions, and test for sensitivity to the substructure of nucleons in nuclei. Fluctuation-free statistical spectroscopy including the theory and computer programs for interacting-particle densities, spin cutoff factors, occupancies, strength sums, and other expectation values. Proposed research for the coming year in each area is presented.

53823 (INIS-mf–12006, pp. 57-58) **β-decay half-lives.** Staudt, A. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.)); Bender, E.; Klapdor, H.V.; Muto, K. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

The β decay half-lives of neutron-rich isotopes with Z=6-108 between the line of beta stability and the neutron drip line are calculated in second generation microscopic calculations using the QRPA with a Gamow-Teller residual interaction. As an astrophysical application of the calculated strength functions the neutrino capture cross sections of ^{69,71}Ga are discussed. (orig.).

53824 (INIS-mf–12006, pp. 58) **Calculation of β-delayed processes.** Staudt, A. (Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.)); Bender, E.; Klapdor, H.V.; Muto, K. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

The results of the calculations of the β-strength functions are used to predict β-delayed neutron emission and β-delayed fission probabilities (P_n and $P_{\beta df}$). The results are of importance for the smoothing of the odd-even staggering in the final element abundances in the astrophysical r-process. The fission rates may have considerable influence on the production of heavy elements in nature as well as in thermonuclear explosions. (orig.).

53825 (INIS-mf–12006, pp. 58-60) **Calculation of 2ν double beta decay for ^{100}Mo, ^{136}Xe and ^{150}Nd in the QRPA.** Muto, K.; Bender, E.; Klapdor, H.V. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Half-lives of 2ν $\beta\beta$ decay are calculated in the quasiparticle random phase approximation (QRPA) with a realistic nucleon-nucleon interaction. Limitations of the QRFA approach are investigated. (orig.).

53826 (INIS-mf–12006, pp. 63-64) **Total Gamow-Teller strengths from measured g.s. correlations.** Knoepfle, K.T.; Mairle, G.; Seeger, M. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Recently developed model-independent sum rules for Gamow-Teller transitions as observed in (p,n) and (n,p) reactions are applied to all stable even-even target nuclei between ^{16}O and ^{58}Ni and to ^{90}Zr. The total Gamow-Teller strengths S(p,n) and S(n,p),

which depend sensitively on ground state correlations, are calculated by the use of measured occupation numbers deduced from proton- and neutron-pickup and stripping experiments. The results are at variance with experimental observations, thus leaving the problem of the missing Gamow-Teller strengths in (p,n) and (n,p) reactions unresolved. (orig.).

53827 (INIS-mf–12006, pp. 76-78) **Coulomb scattering of aligned heavy ions.** Grawert, G.; Voelk, H.G.; Becker, K.; Derner, J.C.; Fick, D.; Korsch, W.; Leucker, H.; Luck, W.; Pohlenz, D.; Reich, H. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

A new formalism to describe the Coulomb scattering of polarized heavy ions has been developed. ^{7}Li scattering data have been reanalyzed with this theory. Measurements for the scattering of polarized ^{23}Na are in progress. (orig.).

53828 (INIS-mf–12006, pp. 112) **Sensitivity of compound-nucleus observables to time-reversal non-invariance.** Davis, E.D.; Hartmann, U. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Published in summary form only. T INVARIANCE/compound-nucleus reactions; COMPOUND-NUCLEUS REACTIONS/detailed balance principle; NEUTRON REACTIONS/resonance scattering; SYMMETRY BREAKING; NUCLEON-NUCLEON INTERACTIONS; COMPOUND NUCLEI; POLARIZED BEAMS; RESONANCE; SPIN ORIENTATION; SCATTERING; RESONANCE NEUTRONS; EXPECTATION VALUE; ERICSON THEORY; NUCLEAR STRUCTURE; LIMITING VALUES; P INVARIANCE

53829 (INIS-mf–12006, pp. 112) **Error calculation for experiments to detailed balance.** Huepper, A.; Harney, H.L. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Published in summary form only. T INVARIANCE/nuclear reactions; NUCLEAR REACTIONS/detailed balance principle; SYMMETRY BREAKING; CORRELATIONS; ERRORS; LIMITING VALUES; PROBABILITY; SCATTERING AMPLITUDES; CROSS SECTIONS; EXPECTATION VALUE

53830 (INIS-mf–12006, pp. 112) **Parity violation in statistical nuclear reactions.** Mueller, A.; Harney, H.L. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Published in summary form only. P INVARIANCE/nuclear reactions; NUCLEAR REACTIONS/statistical models; RESONANCE; EXPECTATION VALUE; SYMMETRY BREAKING; NEUTRON REACTIONS; LIMITING VALUES; UNITARITY

53831 (INIS-mf–12006, pp. 112) **A statistical two-level-model.** Meyer, M.; Harney, H.L. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Published in summary form only. NUCLEAR REACTIONS/statistical models; RESONANCE; MATRICES; RANDOMNESS; NUCLEAR STRUCTURE; NUCLEAR MODELS

53832 (INIS-mf–12006, pp. 113) **Coexistence of collectivity and chaos in nuclei.** Guhr, T.; Weidenmueller, H.A. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Published in summary form only. COLLECTIVE MODEL/stochastic processes; NUCLEAR STRUCTURE; GIANT RESONANCE; ISOBARIC ANALOGS; MATRICES; RANDOMNESS; HAMILTONIANS; FLUCTUATIONS; HEAVY NUCLEI; INTERMEDIATE MASS NUCLEI

53833 (INIS-mf–12006, pp. 113) **Isospin mixing and fluctuation properties.** Guhr, T.; Weidenmueller, H.A. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Published in summary form only. NUCLEAR STRUCTURE/fluctuations; CONFIGURATION MIXING; ENERGY-LEVEL DENSITY; ISOSPIN; FLUCTUATIONS; GAUSSIAN PROCESSES; WIGNER DISTRIBUTION; COULOMB FIELD; MATRIX ELEMENTS; HAMILTONIANS; QUANTUM NUMBERS

53834 (INIS-mf–12006, pp. 114) **QMD versus BUU/VUU - same results from different theories.** Aichelin, J. (Heidelberg Univ. (Germany, F.R.). Inst. fuer Theoretische Physik); Bohnet, A.; Rosenhauer, A.; Peilert, G.; Stoecker, H.; Greiner, W. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Published in summary form only. HEAVY ION REACTIONS/nuclear reaction kinetics; LONGITUDINAL MOMENTUM; TRANSVERSE MOMENTUM; DIFFERENTIAL CROSS SECTIONS; MULTIPLICITY; MULTIPLE PRODUCTION; LINEAR MOMENTUM TRANSFER; DISTRIBUTION FUNCTIONS; EXCLUSIVE INTERACTIONS; NUCLEON-NUCLEON INTERACTIONS; NUCLEONS; TIME DEPENDENCE; HARTREE-FOCK METHOD; POTENTIAL SCATTERING; BOLTZMANN-VLASOV EQUATION; WIGNER DISTRIBUTION; GAUSSIAN PROCESSES; QUANTUM MECHANICS; WAVE FUNCTIONS; MEV RANGE 100-1000; COMPARATIVE EVALUATIONS

53835 (INIS-mf–12006, pp. 115) **Gluon multiple scattering and the transverse momentum dependence of J/psi production in nucleus-nucleus collisions.** Huefner, J. (Heidelberg Univ. (Germany, F.R.). Inst. fuer Theoretische Physik); Kurihara, Y.; Pirner, H.J. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Published in summary form only. HEAVY ION REACTIONS/particle production; MULTIPLE SCATTERING; TRANSVERSE MOMENTUM; GLUON MODEL; J PSI-3097 MESONS; GLUONS; RELATIVISTIC RANGE; GEV RANGE 100-1000; PROTON REACTIONS; NUCLEAR REACTION KINETICS

53836 (INIS-mf–12006, pp. 115) **How useful is the concept of y scaling?.** Yen, G. (Ohio State Univ., Columbus (USA). Dept. of Physics); Harindranath, A.; Vary, J.P.; Pirner, H.J. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Published in summary form only. DEUTERIUM TARGET/electron reactions; ELECTRON REACTIONS/deep inelastic scattering; SCALING LAWS; ASYMPTOTIC SOLUTIONS; INCLUSIVE INTERACTIONS; PARTICLE RAPIDITY; NUCLEAR STRUCTURE; RELATIVISTIC RANGE; TWO-BODY PROBLEM

53837 (INIS-mf–12006, pp. 116) **The adiabatic cranking model for large amplitudes.** Ivanyuk, F.A. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Published in summary form only. CRANKING MODEL/adiabatic approximation; DENSITY MATRIX; COLLECTIVE MODEL; NUCLEAR STRUCTURE; NUCLEON-NUCLEON INTERACTIONS; NUCLEAR DEFORMATION; NUCLEAR MATTER; EFFECTIVE MASS; OCCUPATION NUMBER; KINETIC EQUATIONS; TWO-BODY PROBLEM; DIFFERENTIAL CALCULUS; FRICTION; NUCLEONS; RELAXATION; RELAXATION TIME; IRREVERSIBLE PROCESSES

53838 (ISN–88-72) **Giant dipole modes in heavy-ion reactions.** Suraud, E.; Schuck, P.; Pi, M. Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires. Jul 1988. 46p. Order Number DE90713762. Available from NTIS (US Sales Only), PC A03/MF A01.

A detailed study of the excitation of giant dipole modes (GDR) in intermediate energy heavy-ion collisions is presented in the framework of a full (non linearized) Landau-Vlasov equation. After having recalled the basic inputs of this dynamical formalism, within insisting upon the limitations of the Uehling-Uhlenbeck collision integral and upon the introduction of a realistic (isospin dependant) effective interaction, we present our tools for analysing the GDR in the simple case of isolated nuclei. We then pass on to simulations of collisions and discuss in some detail isospin modes in the model $^{12}Be + ^{12}C$ reaction. Results obtained for the energy of the excited dipole mode are in agreement with what is expected for excited, rotating, giant dipole oscillations in deformed nuclei.

53839 (LAPP-TH–238-89) **Higgs boson production at CLIC in Susy models with hierarchy of the vacuum expectation values.** Chiappetta, P.; Kalinowski, J. Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules. Jan 1989. 15p. Order Number DE90713767. Available from NTIS (US Sales Only), PC A03/MF A01.

We discuss mechanisms for production at CLIC energy of neutral Higgs bosons of the minimal supersymmetric model. In particular we concentrate on scenarios with a large ratio of the vacuum expectation values $v_2/v_1 \simeq m_t/m_b$.

53840 (LA-UR–89-3198) **Algebraic description of intrinsic modes in nuclei.** Leviatan, A. Los Alamos National Lab., NM (USA). [1989]. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-8907150–1: 12. course of the International School of Nuclear Physics: the nature of hadrons and nuclei studied by electron scattering, Erice (Italy), 16-25 Jul 1989). Order Number DE90000691. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

We present a procedure for extracting normal modes in algebraic number-conserving systems of interacting bosons relevant for collective states in even-even nuclei. The Hamiltonian is resolved into intrinsic (bandhead related) and collective (in-band related) parts. Shape parameters are introduced through non-spherical boson bases. Intrinsic modes decoupled from the spurious modes are obtained from the intinsic part of the Hamiltonian in the limit of large number of bosons. Intrinsic states are constructed and serve to evaluate electromagnetic transition rates. The method is illustrated for systems with one type of boson as well as with proton-neutron bosons. 28 refs., 1 fig.

53841 (LBL–27502) **Thermal and statistical properties of nuclei and nuclear systems.** Moretto, L.G.; Wozniak, G.J. Lawrence Berkeley Lab., CA (USA). Jul 1989. 102p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-8907154–1: Enrico Fermi summer course CX11: nuclear collisions from the mean field into the fragmentation regime, Varenna (Italy), 11-21 Jul 1989). Order Number DE90000183. Available from NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.

The term statistical decay, statistical or thermodynamic equilibrium, thermalization, temperature, etc., have been used in nuclear physics since the introduction of the compound nucleus (CN) concept, and they are still used, perhaps even more frequently, in the context of intermediate- and high-energy heavy-ion reactions. Unfortunately, the increased popularity of these terms has not made them any clearer, and more often than not one encounters sweeping statements about the alleged statisticity of a nuclear process where the "statistical" connotation is a more apt description of the state of the speaker's mind than of the nuclear reaction. It is our goal, in this short set of lectures, to set at least some ideas straight on this broad and beautiful subject, on the one hand by clarifying some fundamental concepts, on the other by presenting some interesting applications to actual physical cases. 74 refs., 38 figs.

53842 (N–89-25103) **Kaon-nucleus scattering.** Hong, Byungsik; Maung, K.M.; Wilson, J.W.; Buck, W.W. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. 1989. 30p. (NASA-TP–2920;L–16583;NAS–1.60:2920). Available from NTIS, PC A03/MF A01.

The derivations of the Lippmann-Schwinger equation and Watson multiple scattering are given. A simple optical potential is found to be the first term of that series. The number density distribution models of the nucleus, harmonic well, and Woods-Saxon are used without t-matrix taken from the scattering experiments. The parameterized two-body inputs, which are kaon-nucleon total cross sections, elastic slope parameters, and the ratio of the real to the imaginary part of the forward elastic scattering amplitude, are presented. The eikonal approximation was chosen as our solution method to estimate the total and absorptive cross sections for the kaon-nucleus scattering.

53843 (TRI-PP–89-53) **Quenching of the Gamow-Teller matrix element in closed-LS-shell-plus-one nuclei.** Towner, I.S. British Columbia Univ., Vancouver, BC (Canada). TRIUMF Facility. Jun 1989. 3p. (CONF-8906160–3: Yamada conference on nuclear weak process and nuclear structure, Osaka (Japan), 12-15 Jun 1989). Order Number DE90001192. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI.

It is evident that nuclear Gamow-Teller matrix elements determined from β-decay and charge-exchange reactions are significantly quenched compared to simple shell-model estimates based on one-body operators and free-nucleon coupling constants. Here we discuss the theoretical origins of this quenching giving examples from light nuclei near LS-closed shells, such as ^{16}O and ^{40}Ca. 12 refs., 2 tabs.

53844 (UCRL–101906) **Consequences of dynamic and phase space constraints in medium energy heavy ion collisions.** Blann, M. Lawrence Livermore National Lab., CA (USA). Oct 1989. 14p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8910237–1: International school seminar on heavy ion physics, Dubna (USSR), 3-12 Oct 1989). Order Number DE90000838. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The goals of this presentation are twofold; to summarize the current status of the interpretation of energetic γ-rays in heavy ion collisions via the n-p-bremsstrahlung mechanism, and to look briefly at the topic of multi-fragmentation. One tool will be used as the basis of the first topic, and as an essential element of the second, i.e. a transport equation to approximate the fast non-equilibrium nucleon-nucleon cascade/emission stage of the reaction. It is during this stage that we expect the n-p-bremsstrahlung processes to produce energetic photons. We will also use the transport model to estimate the average equilibrated nucleus produced in a heavy ion reaction, and then investigate the multi-fragmentation expectation of such an equilibrated nucleus using a straightforward evaporation model. With these two goals in mind I shall begin with a very brief description of the Boltzmann master equation (BME) model which will be used as the transport code, deferring to earlier works for a more complete description, and present but a single representative comparison with an experimental neutron emission spectrum. I shall then summarize the status of the elementary n-p-γ cross section needed to extend the transport code to photon emission in heavy ion reactions, and summarize the status of these comparisons with data. Next the BME will be used to estimate the mass, charge and excitation of the average equilibrated nucleus formed in the interaction of 35 MeV/nucleon ^{36}Ar with ^{238}U; a case which has been investigated recently. I shall describe the manner used to treat the de-excitation of this system via Weisskopf evaporation theory, and compare calculated and measured multi-fragmentation multiplicity yields. 33 refs., 10 figs.

53845 An octupole two-phonon multiplet in ^{96}Zr and its description within the spdf interacting boson model. Kusnezov, D.F. (Michigan State Univ., East Lansing (USA). Dept. of Physics and Astronomy); Henry, E.A.; Meyer, R.A. *Physics Letters [Section] B (Netherlands)*, 228(1): 11-15 (7 Sep 1989).

Members of a two-phonon octupole vibrational multiplet in ^{96}Zr and their mixing with other positive parity levels are discussed. Calculations within the spdf boson version of the interacting boson model which includes intruder configuration mixing are compared with the experimentally observed properties. (orig.).

53846 Fusion rates of squeezed and screened hydrogenic nuclei. Benesh, C.J. (Physics Department, Iowa State University, Ames, Iowa 50011 (US)); Vary, J.P. *Physical Review [Section] C: Nuclear Physics (USA)*, 40(2): 495-496 (Aug 1989).

We calculate the barrier penetration factor for hydrogen-like ions confined in a potential well as a function of the equilibrium separation and screening length of the medium. We show the penetration factor is extremely sensitive to these parameters, independently and in combination. The parameter values required to produce the high fusion rates reported for palladium hydride systems, however, are far from typical for these systems.

53847 Branching ratios for ^{3}He$(\alpha,\gamma)^7$Be and ^{3}H$(\alpha,\gamma)^7$Li. Kajino, T. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550 (US)); Mathews, G.J.; Ikeda, K. *Physical Review [Section] C: Nuclear Physics (USA)*, 40(2): 525-530 (Aug 1989). DOE Contract W-7405-ENG-48.

Branching ratios for radiative alpha capture by tritium and ^{3}He have been studied in a kinematical direct capture model for the purpose of obtaining an independent derivation of the ^{3}H$(\alpha,\gamma)^7$Li branching ratio and possibly resolving an apparent discrepancy in the experimentally measured value. From the mirror symmetry between ^{7}Li and ^{7}Be, and the observed branching ratio $R(0)=0.38\pm0.04(1\sigma)$ for the ^{3}He$(\alpha,\gamma)^7$Be reaction, the branching ratio for the ^{3}H$(\alpha,\gamma)^7$Li reaction is constrained to be $R(0)=0.47\pm0.07$, which agrees best with the higher measured value. The implication of these results for big-bang nucleosynthesis in standard and nonstandard models is discussed.

53848 Possible dynamic effects in the particle decay of ^{59}Cu compound nuclei. Fornal, B. (Institute of Nuclear Physics, Cracow, Poland (PL)); Viesti, G.; Nebbia, G.; Prete, G. *Physical Review [Section] C: Nuclear Physics (USA)*, 40(2): 664-667 (Aug 1989).

The slopes of the energy spectra of p, d, t, and α particles emitted from ^{59}Cu nuclei formed in the reaction of ^{32}S+^{27}Al at a bombarding energy of 150 MeV are described by statistical-model calculations in which the deformation is frozen during the first two steps of the deexcitation chain. The resultant fits to the high-energy portions of the spectra are comparable to those previously obtained by modifying the spin dependence of the level density, suggesting that dynamic effects may be important in evaporation from light nuclei.

53849 Influence of rotation-induced nuclear deformation on α-particle evaporation spectra. Huizenga, J.R. (Department of Chemistry and Nuclear Structure Research Laboratory, University of Rochester, Rochester, New York 14627 (US)); Behkami, A.N.; Govil, I.M.; Schroder, W.U.; Toke, J. *Physical Review [Section] C: Nuclear Physics (USA)*, 40(2): 668-680 (Aug 1989).

The shapes of α-particle spectra from hot, high-spin compound nuclei produced in energetic heavy-ion fusion reactions are analyzed within the framework of a statistical model. Contrary to claims made in the literature, good agreement is obtained between calculated and experimental spectra when the evaporation barrier of each nuclide in the complex cascade is assumed equal to its respective absorption channel barrier. The dependence of the shape of α-particle spectra on nuclear deformation is discussed both in terms of the transmission coefficients and the spin-dependent level density of deformed nuclei. For deformations of the magnitude given by the rotating liquid drop model, α-particle spectra and effective barriers are insensitive to whether deformed or spherical nucleus transmission coefficients are used. It is important, however, to include the deformation dependence in the nuclear level density. Model calculations indicate that the shape of α-particle spectra may be quite insensitive to large deformations.

53850 Spin-orbit force in time-dependent Hartree-Fock calculations of heavy-ion collisions. Umar, A.S. (Department of Physics and Astronomy, Vanderbilt University, Nashville, Tennessee 37235 (US)); Strayer, M.R.; Reinhard, P.; Davies, K.T.R.; Lee, S. *Physical Review [Section] C: Nuclear Physics (USA)*, 40(2): 706-714 (Aug 1989). DOE Contract AC05-84OR21400.

We discuss the time-dependent Hartree-Fock equations which maintain independent nucleon spin degrees of freedom, and which include spin-orbit interactions. The complex numerical task of including the spin-orbit force in reaction studies is described in detail.

53851 Final-state interactions and relativistic effects in the quasielastic (e,e') reaction. Chinn, C.R. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742 (US)); Picklesimer, A.; Van Orden, J.W. *Physical Review [Section] C: Nuclear Physics (USA)*, 40(2): 790-812 (Aug 1989).

The longitudinal and transverse response functions for the inclusive quasielastic (e,e') reaction are analyzed in detail. A microscopic theoretical framework for the many-body reaction provides a clear conceptual (nonrelativistic) basis for treating final-state interactions and goes far beyond simple plane-wave or Hermitean potential models. The many-body physics of inelastic final-state channels as described by optical and multiple scattering theories is properly included by incorporating a full complex optical potential. Explicit nonrelativistic and relativistic momentum-space calculations quantitatively demonstrate the importance of such a treatment of final-state interactions for both the transverse and longitudinal response. Nonrelativistic calculations are performed using final-state interactions based on phenomenology, local density models, and microscopic multiple scattering theory. Relativistic calculations span a similar range of models and employ Dirac bound-state wave functions. The theoretical extension to relativistic dynamics is of course not clear, but is done in obvious parallel to elastic proton scattering. Extensive calculations are performed for ^{40}Ca at momentum transfers of 410, 550, and 700 MeV/c. A number of interesting physical effects are observed, including significant relativistic suppressions (especially for R_L), large off-shell and virtual pair effects, enhancement of the tails of the response by the final-state interactions, and large qualitative and even shape distinctions between the predictions of the various models of the final-state interactions. None of the models is found to be able to simultaneously predict the data for both response functions. This strongly suggests that additional physical mechanisms are of qualitative importance in inclusive quasielastic electron scattering.

53852 Proton-induced production of η on nuclei. Liu, L. (Isotope and Nuclear Chemistry Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87544 (US)); Londergan, J.T.; Walker, G.E. *Physical Review [Section] C: Nuclear Physics (USA)*, 40(2): 832-842 (Aug 1989).

The features of the $(p,p'\eta)$ reaction are examined for incident proton energies between 0.8 and 1.6 GeV. Reactions are calculated for exclusive transitions in which the continuum proton and η are observed in coincidence. This process should be dominated by transitions $N+N\rightarrow N+N+\eta$ involving intermediate excitation of one of the nucleons to an $N(1535)$ isobar. We take phenomenological amplitudes for the process $\pi+N\rightarrow\eta+N$ in the nuclear medium. A theoretical formalism for the reaction amplitudes is derived and examined in detail. Nuclear distortions of the hadrons are estimated in the eikonal approximation. The theoretical cross sections are shown to be dominated by a single production amplitude. This results in the prediction that η production should occur entirely through $\Delta T=1$ non-normal parity nuclear transitions; i.e., that the nuclear states excited should show the spin-isospin characteristics of the exchanged meson. Peak reaction cross sections are predicted to have a strong dependence on the incident proton energy. Expected peak cross sections, for a target like ^{16}O, are on the order of 1 μb/sr^2 MeV.

53853 Off-shell effects from meson exchange in the nuclear optical potential. Elster, C. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742 (US)); Tandy, P.C. *Physical Review [Section] C: Nuclear Physics (USA)*, 40(2): 881-886 (Aug 1989).

First-order Kerman-McManus-Thaler nuclear optical potentials for intermediate energy protons are constructed from realistic meson-exchange models of the nucleon-nucleon interaction including off-shell effects. At 200 MeV the full model developed by the Bonn group is employed, while at 500 MeV a simplified version with delta resonance inelasticity is used. The resulting off-shell effects on the nuclear scattering spin observables are found to be substantial.

53854 Observable effects of poles and shadow poles in coupled-channel systems. Pearce, B.C. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545 (US)); Gibson, B.F. *Physical Review [Section] C: Nuclear Physics (USA)*, 40(2): 902-911 (Aug 1989).

Using separable potentials in a coupled-channel Lippmann-Schwinger equation, we investigate the motion of poles on the different Riemann sheets and their observable effects as the coupling strength is varied. Only in the weak-coupling limit can one determine in which uncoupled channel the pole originated by the sheet on which it lies. Cusp structure versus resonance peak as one crosses a threshold is found to depend on the distance of the pole from the physical sheet. Resonance poles in each uncoupled channel can produce double-loop Argand plots similar to those seen in πN P_{11} amplitude analysis.

53855 **Generalization of the sum rule for double Gamow-Teller operators.** Zheng, D.C. (Department of Physics and Astronomy, Rutgers University, Piscataway, New Jersey 08855 (US)); Zamick, L.; Auerbach, N. *Physical Review [Section] C: Nuclear Physics (USA),* 40(2): 936-939 (Aug 1989).

We show that for Pauli-blocked nuclei, in the closure approximation, the summed strength for the double Gamow-Teller $0^+ \rightarrow 0^+$ transitions is *less* than the value $6(N-Z)(N-Z+1)$ and that the difference can be related to sum rules for magnetic dipole transitions, which in turn can be related to the double Gamow-Teller matrix element for the transition from the 0^+ initial state to its double isobaric analog state. A "wrong isospin phase sum rule" is found that is valid in limited cases.

53856 **Adiabatic time-dependent Hartree-Fock theory in the generalized valley approximation.** Bulgac, A. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104 (US)); Klein, A.; Walet, N.R.; Do Dang, G. *Physical Review [Section] C: Nuclear Physics (USA),* 40(2): 945-959 (Aug 1989).

A classical theory of large amplitude, adiabatic collective motion, developed and applied previously to test examples, is transcribed into the language of time-dependent Hartree-Fock theory in order to initiate the application of the new method to problems in nuclear physics. The formulation which emerges can be characterized as a generalized cranking theory, in the sense that the cranking operator cannot be chosen arbitrarily, as in the conventional formulation of this method, but is instead fully constrained by the formalism. A procedure for obtaining approximate solutions to the new equations is described and illustrated with several simplified many-body models. It is inferred that traditional cranking calculations can serve as starting points for more realistic models. This paper also includes additional discussion concerning the calculation of collective masses and the problem of local stability of collective motion, not covered in our previous work.

53857 **Parton bremsstrahlung as a mechanism of energy deposition in high-energy hadron-nucleus and nucleus-nucleus collisions.** Mrowczynski, S. (Department of Physics, University of Arizona, Tucson, Arizona 85721 (US)); Rafelski, J. *Physical Review [Section] C: Nuclear Physics (USA),* 40(2): 1077-1080 (Aug 1989).

On the basis of perturbative quantum chromodynamics, we consider the bremsstrahlung energy losses of partons traversing *parton matter* using the well-known quantum electrodynamical formulas. We find the transport equation describing the energy distribution of partons as a function of thickness of a target. The equation is solved numerically and we briefly discuss the relevance of our results for hadron-nucleus and nucleus-nucleus collisions at high energies.

53858 **Comparison of two methods for calculating finite-temperature ring diagrams.** Yang, S.D. (Department of Physics, State University of New York at Stony Brook, Stony Brook, New York 11794 (US)); Jiang, M.F.; Kuo, T.T.S.; Ellis, P.J. *Physical Review [Section] C: Nuclear Physics (USA),* 40(2): 1085-1088 (Aug 1989).

Certain types of ring diagrams of the thermodynamic potential Ω can be summed up to all orders using two apparently very different methods—the eigenvalue method and the transition-amplitude method. A relatively simple derivation of these methods is given, and we show that these two methods are exactly equivalent to each other. To study their numerical applications we have calculated the particle-particle, hole-hole ring diagrams of Ω for nuclear matter with both methods, using a modified Gogny interaction. Our results suggest that the strength-parameter integration involved in the transition-amplitude method can be accurately performed using a small number of mesh points and both methods seem to be suitable for numerical calculations.

6540 Radiation and Shielding Physics

Refer also to citation(s) 51948, 51958, 51972, 52023, 52244, 52938, 53876, 53899

53859 (CONF-8909210–1) **Direction-dependent stopping power and beam deflection in anisotropic solids.** Crawford, O.H. Oak Ridge National Lab., TN (USA). 1989. 15p. Sponsored by U.S. Department of Defense; U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. Order Number DE90001076. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Directional effects on the motion of swift ions in anisotropic media are studied. The stopping power is a function of the direction of the velocity relative to the principle axes of the medium, and there is a nonzero lateral force on the ion tending to bend its trajectory. These effects arise from the anisotropy of the dielectric response, and are distinct from channeling. Simple expressions are derived for the stopping power and lateral force in the nonrelativistic high-velocity limit, and calculations are performed for crystalline graphite. 6 refs., 7 figs.

53860 (CONF-8909210–2) **Interaction of low-energy electrons and positrons with condensed matter: Stopping powers and inelastic mean free paths from optical data.** Ashley, J.C. Oak Ridge National Lab., TN (USA). [1989]. 19p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. Order Number DE90001001. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

An "optical-data model" is described for evaluating energy loss per unit pathlength and inelastic mean free path for low-energy electrons and positrons ($\lesssim$ 10 keV) from optical data on the medium of interest. Exchange between the incident electron and electrons in the medium is included. Results from the optical-data model are compared with previous theoretical calculations. 15 refs., 6 figs., 2 tabs.

53861 (INIS-SU–119/A) **Neutron physics. V. 3.** Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1988. 372p. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev (USSR), 14-18 Sep 1987). Order Number DE90705913. Available from NTIS (US Sales Only), PC A16/MF A01 - OSTI; INIS.

T-12589.

Individual papers in this conference proceedings are indexed separately.

53862 (KURRI-TR–317) **Calorimetric measurement of the heat deposition in an aluminum alloy in the KUR graphite-thermal-column.** Kawai, Takeshi; Utsuro, Masahiko; Okamoto, Sunao. Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Mar 1989. 18p. (In Japanese). Order Number DE90709975. Available from NTIS (US Sales Only), PC A03/MF A01.

We describe a calorimetric experiment to measure the heat deposition in an aluminum alloy in the KUR graphite-thermal column where the cold-moderator cell of the KUR cold neutron source would be set up. A cartridge-electric-heater imbedded in a spherical sample was used to estimate accurately the heat deposition by comparing the rate of temperature rise in case of heater power with that of reactor power. The heat deposition of 0.1 W/cm^3 was obtained at 5MW reactor power. (author).

53863 (N–89-24255) **A hierarchy of transport approximations for high energy heavy (HZE) ions.** Wilson, J.W.; Lamkin, S.L.; Hamidullah, F.; Ganapol, B.D.; Townsend, L.W. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. Jul 1989. 39p. (NASA-TM–4118;L–16572;NAS–1.15:4118). Available from NTIS, PC A03/MF A01.

The transport of high energy heavy (HZE) ions through bulk materials is studied neglecting energy dependence of the nuclear cross

sections. A three term perturbation expansion appears to be adequate for most practical applications for which penetration depths are less than 30 g per sq cm of material. The differential energy flux is found for monoenergetic beams and for realistic ion beam spectral distributions. An approximate formalism is given to estimate higher-order terms.

53864 (SAAS–377) **Attenuation coefficients of soils.** Martini, E.; Naziry, M.J. Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic). 1989. 20p. (In German). Order Number DE90606105. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

As a prerequisite to the interpretation of gamma-spectrometric in situ measurements of activity concentrations of soil radionuclides the attenuation of 60 to 1332 keV gamma radiation by soil samples varying in water content and density has been investigated. A useful empirical equation could be set up to describe the dependence of the mass attenuation coefficient upon photon energy for soil with a mean water content of 10%, with the results comparing well with data in the literature. The mean density of soil in the GDR was estimated at 1.6 g/cm^3. This value was used to derive the linear attenuation coefficients, their range of variation being 10%. 7 figs., 5 tabs. (author).

53865 Asymptotic solutions of numerical transport problems in optically thick, diffusive regimes II. Larsen, E.W. (Department of Nuclear Engineering, The University of Michigan, Ann Arbor, Michigan 48109 (US)); Morel, J.E. *Journal of Computational Physics (USA),* 83(1): 212-236 (Jul 1989).

In a recent article (Larsen, Morel, and Miller, *J. Comput. Phys.* **69**, 283 (1987)), a theoretical method is described for assessing the accuracy of transport differencing schemes in highly scattering media with optically thick spatial meshes. In the present article, this method is extended to enable one to determine the accuracy of such schemes in the presence of numerically unresolved boundary layers. Numerical results are presented that demonstrate the validity and accuracy of our analysis. © 1989 Academic Press, Inc.

53866 Algorithms for solving inverse problems of transport theory. McCormick, N.J. *Transactions of the American Nuclear Society (USA),* 56: 254-255 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Inverse problems based on the neutral particle time-(in)dependent integrodifferential transport equation require measurement of the angular distribution of the particles for at least one spatial location (and sometimes more) in order to infer some property of the medium. While algorithms for solving inverse transport problems can appear to be straightforward to evaluate, they often are poorly conditioned (or ill posed) in the sense that small errors in measurements or an insufficient number of measurement directions can lead to unacceptably large errors in the desired result. This paper summarizes the status of the mathematical development and the numerical and (where applicable) experimental performance of time-(in)dependent inverse problem algorithms.

53867 Use of adjoint transport solutions for inverse problems. Renken, J.H. *Transactions of the American Nuclear Society (USA),* 56: 256-257 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Inverse problems represent a third major class of transport problems (after criticality-type problems and shielding-type problems). For the purpose of discussion here, an inverse problem is defined to be one in which a medium of interest emits some particular type of radiation, either spontaneously or when exposed to some other type of radiation. From a knowledge of the emitted radiation characteristics, one wishes to infer something about the medium that emits the detected radiation. An important example of a practical inverse problem is the geophysical logging of geological formations to determine the presence of minerals or hydrocarbons in the vicinity of a borehole. Proposals have also been made to detect hidden explosives by these methods. For a complete understanding of the apparatus used to solve inverse problems, it is important to know the characteristic interrogation distance of the method. Phrased more precisely, What is the relative contribution to the detector signal due to radiation particles emitted by different elements of volume in the medium being interrogated? As shown in the paper, it is possible to address this question with a computational procedure that utilizes adjoint transport solutions.

53868 The use of the inverse Monte Carlo method in nuclear engineering. Dunn, W.L. *Transactions of the American Nuclear Society (USA),* 56: 257-258 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The inverse Monte Carlo (IMC) method was introduced in 1981 in an attempt to apply Monte Carlo to the solution of inverse problems. It was argued that if direct Monte Carlo could be used to estimate expected values, which in the continuous case assume the form of definite integrals, then perhaps a variant could be used to solve inverse problems of the type that are posed as integral equations. The IMC method actually converts the inverse problem, through a noniterative simulation technique, into a system of algebraic equations that can be solved by standard analytical or numerical techniques. The principal merits of IMC are that, like direct Monte Carlo, the method can be applied to complex and multivariable problems, and variance reduction procedures can be applied.

53869 Explicit solution of three-dimensional inverse transport problems. Larsen, E.W. *Transactions of the American Nuclear Society (USA),* 56: 259-260 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

In recent year, substantial work has been performed on the problem of determining the cross sections of a system by introducing known steady-state neutron or photon flux distributions through the outer boundary of the system, measuring the exiting flux distributions, and then suitably processing this boundary flux information. In all of this work, the angular fluxes must be known at every point and every angle on the other boundary, and the resulting equations that relate the material cross sections to the incident and exiting boundary fluxes are ill conditioned. Here is proposed an entirely different solution having the following features: 1. The known incident fluxes must by pencil beams, i.e., delta functions in space, angle, and energy. 2. The detectors must be capable of measuring weak delta functions of angle, consisting of the uncollided flux generated by a line source. 3. Our solution is conceptually applicable in any convex geometry. 4. If the physical system is homogeneous, then our solution is explicit, requires only a few measurements, and is well conditioned.

53870 Multidimensional nodal transport methods for multiple-instruction multiple-data, distributed memory machines. Azmy, Y.Y. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society (USA),* 56: 292-293 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

As computer hardware technology approaches the physical limits (on size and speed) of the electronic components of computer systems, it has become evident in recent years that any significant improvements in the performance of future systems must be rooted in advanced architectures. Efforts in this direction have resulted in numerous ideas and designs for vector and parallel processors. Among the many problems that have been implemented on the new systems is the neutron and photon transport equation. Monte Carlo-type methods have been implemented on shared-memory (SM) and distributed-memory (DM) multiple-instruction multiple-data (MIMD) machines. On the other hand, implementation of discrete ordinates-type methods on SM MIMD systems has been considered for general codes as well as special one-dimensional, multigroup codes. More recently, implementation of the latter code on the hypercube and the comparison between two chaotic and one ordered iterative schemes have been reported. In this paper the authors present the implementation of the zeroth and first-order two-dimensional nodal transport methods on the hypercube. The objective is to study the effect of the various parameters in a simple test problem on speedup and efficiency in order to determine the cases most suitable for solving on a DM machine, such as the hypercube.

53871 A nodal method for time-dependent transport equations. Badruzzaman, A. *Transactions of the American Nuclear*

Society (USA), 56: 303-305 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

Numerical time-dependent transport methods implicit in the time variable yield unconditionally stable solutions with mesh ratio, $r = v\Delta t/\Delta x$, greater than unity, thereby allowing large time steps. An explicit scheme, on the other hand, requires $r < 1$ for stability. Pearce and Mitchell showed, however, that the basic difference scheme in the implicit approach can lead to large errors in the solution while being stable. They demonstrated that appropriate explicit algorithms are considerably more accurate, although restricted to small time steps. In this paper the authors report a nodal procedure applied to both the temporal and the spatial variables. Nodal Methods, which retain higher order moments of the solution, have been utilized to solve the static transport equation with much larger cell widths than required by the standard differencing schemes to attain the same accuracy.

53872 **Diffusion synthetic acceleration for S_n problems with reflecting boundaries.** Yavuz, M.; Larsen, E.W. *Transactions of the American Nuclear Society (USA),* 56: 305-306 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The Diffusion Synthetic Acceleration (DSA) method has become a widely used numerical algorithm for accelerating the iterative convergence of S_n problems. The primary advantage of DSA is that it produces, for most problems, an iteration error that is reduced by at least two orders of magnitude for every three iterations. However, for problems in which the entire exterior boundary of the physical system is reflecting (such problems occur in modeling a single cell in an infinite lattice), DSA is much more slowly converging, and in some cases, unstable. Here, the authors explain why this occurs and we describe an easily implemented modification of DSA that yield the same rapid rate of convergence for this type of problem as current DSA now exhibits for other types of problems.

53873 **Supercomputer S_N calculations without observable ray effects or numerical diffusion.** Monahan, S.P.; Filippone, W.L. *Transactions of the American Nuclear Society (USA),* 56: 306-307 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

When developed in the 1950s and 1960s, the discrete ordinates method was tailored for optimum efficiency on the computers of the day. Computation speeds and the available memory of those first computers were extremely poor by today's standards. Nevertheless, the S_N algorithm was and continues to be the method of choice for many transport problems. However, S_N calculations have been plaqued by two serious problems: numerical diffusion and ray effects. The first arises form spatial discretization and can be quite severe near flux discontinuities; the second results from angular discretization and is very pronounced for low scattering media. Although the streaming ray (SR) method eliminates the former problem, it does not eliminate the latter. Here the authors sent a new discrete ordinates method specifically designed for today's large-memory vector computers, which sharply reduces numerical diffusion and eliminates observable ray effects. Although applied here to the Spencer-Lewis electron transport equation, it is believed the method would be equally applicable to neutral particle transport.

53874 **A finite-moments algorithm for transport equations in cylindrical geometry.** Badruzzaman, A. *Transactions of the American Nuclear Society (USA),* 56: 307-308 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

A general-order finite-spatial-moments discrete ordinates method, initially developed in one dimension, has recently been extended to x-y-z geometry. The resulting system of equations was shown to contain the nodal transport (S_N) algorithms and the conventional linear diamond scheme as special cases. In many radiation transport problems, cylindrical geometry is more appropriate, and in this paper the authors derive a generalized moments algorithm in this geometry. Although the derivation is similar, curved geometry introduces special caveats that do not exist in Cartesian geometry. A low-order (constant surface flux) nodal method was tested previously in r-Θ-z geometry without achieving much gain over conventional differencing schemes. Preliminary tests in this paper show that at least a linear assumption is needed to achieve substantial gains.

53875 **Stability analysis of fine-mesh rebalance.** Cefus, G.; Larsen, E.W. *Transactions of the American Nuclear Society (USA),* 56: 309-310 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

One of the oldest and most commonly used algorithms for accelerating the iterative convergence of S_n problems is the rebalance method. Although there are many problems for which rebalance accelerates effectively, there are also many problems (typically having scattering ratios c close to unity or optically thick spatial cells) for which it is unstable. Also, the fact that the rebalance method is nonlinear has inhibited previous theoretical attempts to quantify its stability properties. Here the authors describe a Fourier stability analysis of fine-mesh rebalance (FMR) for a special class of S_n problems; numerical experimentation, however, shows that this analysis accurately predicts the stability of FMR over a much larger class of problems.

6550 Medical Physics

Refer also to citation(s) 52304, 52305, 52306, 52307, 52309, 52315, 52316, 52317, 52318, 52319, 52321, 52328, 53354, 53422, 53434, 53435, 53438, 53439, 53458

53876 (GSF-S–24/88) **Simulation of electron tracks in the energy range of 0.01 to 10 keV in water vapour.** Paretzke, H.G. Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Jan 1988. 91p. (In German). Contract EEC BI-6-011-D(B). Order Number DE90711226. Available from NTIS (US Sales Only), PC A05/MF A01.

The primary aim of this study was to develop a numerical program for simulating electron traces in steam for the energy range of 0.01 to 10 keV, and to prove the quality of the simulation by comparing calculations with measurements from current literature. Moreover, the application range of the program was to be shown by means of practical examples. The task could be performed by applying the Platzman method for analyzing experimental data with respect to their necessary consistency with established theoretical knowledge. The differential oscillator strength distribution, major differential ionization cross-sections and cross-sections for excitation and elastic collision were derived. By comparing major integral factors (e.g., W value (Co80)) with calculated results, it was possible to determine, e.g., the secondary electron cross-sections with the help of consistency tests. These derived activation cross-sections were used as the core of a Monte Carlo calculation programme (MOCA 87) for simulating electron trace structures which were evaluated in such a way that various calculation values could be compared critically with values obtained experimentally (e.g., for yields, depth and radial dose curves, micro-dosimetric distribution). On the whole, the programme exhibited sufficient consistency. (orig./HP).

53877 (IAE–4529-3) **Radiation safety of thorium nuclear fuel cycle.** Demin, V.F.; Zakharchenko, I.E.; Tsurikov, D.F. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1987. 20p. (In Russian). Order Number DE90606542. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

T-17668.

On the basis of theoretical calculations and analysis of existing data on the experience of operation of nuclear power enterprises an attempt is made to estimate the expected radiological health hazards to personnel and population at all stages of thorium nuclear fuel cycle (NFC). The potential radiological hazard of radioactive NFC wastes does not increase during the transfer from uranium-plutonium fuel to uranium-thorium one. 12 refs.; 1 fig.; 6 tabs.

53878 (IAEA-AL–019, pp. 93-117) **Development of intervention levels for the protection of the public in the event of a major nuclear accident - Past, present and future.** Emmerson, B.W. (International Atomic Energy Agency, Vienna (Austria)). International Atomic Energy Agency, Seibersdorf (Austria). Laboratories. 1989. (CONF-8809405–: Consultants' meeting on rapid instrumental

and separation methods for monitoring radionuclides in food and environmental samples, Vienna (Austria), 5-9 Sep 1988). In *Report of the consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna, 5-9 September 1988.* Order Number DE90603824. Available from NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS.

Since the mid-1950's nuclear energy has played an increasing role in meeting the world demand for electricity production. Although during this period incidents and accidents have occurred, in most cases their effect was confined to the plant. Three accidents, however, were sufficiently serious as to involve off-site consequences for the public. The experience from each contributed significantly in the development of current emergency response criteria and planning arrangements at the national and international level. This paper summarizes these contributions as they relate to the development of intervention levels for the protection of the public in the event of an accidental release of radioactive materials to the environment. It indicates the various measures taken by those countries that were affected by the release from the Chernobyl accident and reviews the subsequent actions by relevant international organizations to provide more comprehensive guidance on applying the principles of intervention and developing derived levels, particularly those aimed at controlling the consumption of contaminated foodstuffs, or their movement in international trade. Finally, it considers the prospects for developing a more harmonized intervention approach based on the guidance now being completed at the international level. (author). 25 refs, 2 figs, 7 tabs.

53879 (IAEA-AL–019, pp. 153-179) **Spectrometrical system for monitoring radionuclides in environmental samples in Poland.** Pietruszewski, A. (Centralne Lab. Ochrony Radiologicznej, Warsaw (Poland)); Rzymkowski, T. International Atomic Energy Agency, Seibersdorf (Austria). Laboratories. 1989. (CONF-8809405– : Consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna (Austria), 5-9 Sep 1988). In *Report of the consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna, 5-9 September 1988.* Order Number DE90603824. Available from NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS.

Since the beginning of 1988 the governmental programme in Poland of coordinated research in the field of radiological protection is being carried on. This programme, in which over 10 different institutes are involved is called "Radiological Protection and Nuclear Safety" and its actual schedule is foreseen up to 1990. There are over 40 separate projects in this programme which constitute 5 main tasks of this programme: (1) System of continuous radiological monitoring of the country. (2) Assessment of radiological hazard to population from natural and artificial radionuclides in the environment. (3) Nuclear safety and radiological protection of nuclear facilities. (4) Technical means for personal radiological protection and decontamination in case of nuclear accident. (5) Biological and medical problems of radiological protection. 14 figs, 1 tab.

53880 (IAEA-AL–019, pp. 185-189) **Radionuclides - correlations - possible uses.** Prakash, S. (Bhabha Atomic Research Centre, Bombay (India)). International Atomic Energy Agency, Seibersdorf (Austria). Laboratories. 1989. (CONF-8809405–: Consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna (Austria), 5-9 Sep 1988). In *Report of the consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna, 5-9 September 1988.* Order Number DE90603824. Available from NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS.

The report describes a rapid method to be used in emergency situations for determining actinides and ^{90}Sr in samples. Figs and tab.

53881 (IAEA-AL–019, pp. 191-194) **Design, planning, application, and quality control of methods for rapid measurement of radioactivity in food and environmental samples. Draft for a working paper.** Buchtela, K. (Atominstitut der Oesterreichischen Universitaeten, Vienna (Austria)). International Atomic Energy Agency, Seibersdorf (Austria). Laboratories. 1989. (CONF-8809405– : Consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna (Austria), 5-9 Sep 1988). In *Report of the consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna, 5-9 September 1988.* Order Number DE90603824. Available from NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS.

The report discusses how standard methods can be changed and applied in emergency cases after an accident when information has to be provided as fast as possible.

53882 (IAEA-AL–019, pp. 195-204) **Recommendations of the consultants on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples.** Prakash, S.; Perkins, R.W. International Atomic Energy Agency, Seibersdorf (Austria). Laboratories. 1989. (CONF-8809405–: Consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna (Austria), 5-9 Sep 1988). In *Report of the consultants' meeting on rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna, 5-9 September 1988.* Order Number DE90603824. Available from NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS.

The assessment of any release of radioactivity to the environment is important for the protection of the public health, especially if the released radioactivity can enter the food chain. The assessment demands rapid, reliable and practical techniques for the analysis of various radionuclides. In order to establish a framework for a new Coordinated Research Programme on Rapid Methods, the Agency held a Consultants' Meeting on September 5 to 9 1988 in Vienna. This report has been produced from the deliberations of this meeting.

53883 (INDC(NDS)–221) **IAEA research coordination meeting on X- and gamma-ray standards for detector efficiency calibration, Braunschweig, FRG, 31 May - 2 June 1989. Summary report.** Christmas, P.; Nichols, A.L.; Lemmel, H.D. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jul 1989. 31p. (CONF-8905218–: IAEA research coordination meeting on X- and gamma-ray standards for detector efficiency calibration, Braunschweig (Germany, F.R.), 31 May - 2 jun 1989). Order Number DE90605298. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The final official meeting of the IAEA Coordinated Research Programme on the Measurement and Evaluation of X- and Gamma-ray Standards for Detector Efficiency Calibration was held in Braunschweig from 31 May to 2 June 1989. Work undertaken by the participants was reviewed in detail, and actions were agreed to resolve specific issues and problems. Initial steps were also made to establish a format and procedure for the preparation by mid-1990 of an IAEA Technical Reports Series booklet; the measurements and recommended data will be listed, and an IAEA data file established for issue to all interested organisations. (author). 3 tabs.

53884 (INIS-BR–1679) **Study of a dosimetric methodology for plutonium by means of radiotonicological analysis in urine.** Bellintani, S.A. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). 1988. 111p. (In Portuguese). Order Number DE90606543. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

The present study is mainly concerned with an internal individual monitoring program for workers dealing with ^{239}Pu, by measuring the ^{239}Pu content in their urine. General aspects related with the plutonium radiotoxicity and its chemical, physical and metabolic properties are discussed. The methodology chosen for the ^{239}Pu analyses in urine is based on the wet ashing of the urine sample, followed by the plutonium separation by precipitation with lanthanium nitrate and extraction with thenoyltrifluoroacetone. After the separation, the samples is electrodeposited and the activity measured by alpha spectrometry. The results were then analyzed by taking into account the couting efficiency obtained of 23.72%, the chemical recovery of 85.3% and the lower limit of detection of 1.1 x 10^{-3} Bq. Finally, the bases for the establishment of reference levels for urinary excretion are discussed by considering the maximum permissible body burden (MPBB) and the annual limit of intake (ALI). (author).

53885 (INIS-SU–110/A, pp. 108-113) **Dosimetry of radiopharmaceuticals.** Popov, V.I. Institut Biofiziki, Moscow (USSR). 1988. (In Russian). In *Radiopharmaceuticals in oncology. Collection of scientific papers.* Order Number DE90705929. Available from NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS.
L-41571.

A program which gives values for 17 different organs and systems and of the whole body is developed. The qutgoing data are values of integral activity in the organs-sources obtained on the basis of study of radiopharmaceutical kinetics in the organism of the examinated patients. The program, radiometric complex and shielding methods were used to determine radiation loads of new radiopharmaceuticals such as ^{113}In-indiphore ^{167}Tm-thulininate, ^{133}Ba-chloride. 7 refs.

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Refer also to citation(s) 51959, 51960, 51990, 52018, 52576, 52589, 52599, 52621, 52627, 52664, 52665, 52666, 52673, 52677, 52680, 52681, 52682, 52877, 52900, 52901, 52913, 52918, 52943, 52945, 53037, 53654, 53655, 53926, 54000

53886 (DOE/ER/10742–7) **Development of an x-ray beam line at the NSLS for studies in materials science using x-ray absorption spectroscopy: Final report.** Sayers, D.E. North Carolina State Univ., Raleigh, NC (USA). [1989]. 43p. Sponsored by U.S. DOE Energy Research. DOE Contract AS05-80ER10742. Order Number DE90001456. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

At the time of the submission of the original proposal more than 7 years ago, the X-11 PRT had set as a goal to develop one of the leading and most comprehensive x-ray absorption beam lines in the world. By any measure we have been successful. As is well documented in previous annual progress report and in the NSLS annual reports, our PRT has been extremely productive in a wide range of topics in materials science, solid state physics, chemistry and biology. Well over 100 papers have been published acknowledging the support of this contract and this continues at a rate of about 30 papers per year and about 20 invited presentations per year. Significant in this report are major studies in high T_c compounds, advances in interface studies, new results in premelting phenomena, several pioneering studies in application of XAS to electrochemistry and significant progress in our understanding of the structure of amorphous chalcogenide systems and their photostructural changes.

53887 (INIS-BR–1626) **Study on effect of substituents in α positron of N,N-diethylamides by nuclear magnetic resonance.** Martins, M.A.P. Sao Paulo Univ., SP (Brazil). Inst. de Quimica. 1982. 354p. (In Portuguese). Order Number DE90605723. Available from NTIS (US Sales Only), PC A16/MF A01 - OSTI; INIS.

The effect of a substituent in the α position of some N,N-diethylamides, through the ^{1}H and ^{13}C n.m.r. spectroscopy is studied. Eight N,N-diethylamides having the structure: Y-CH_2-C(O) - NEt_2, where Y=H, Me, Cl, Br, I, OMe, SMe, and NMe_2 were prepared by usual procedures; all these compounds were characterized by their ^{1}H and ^{13}C n.m.r. and infrared spectra, as well as by their elementary analysis. (M.J.C.).

53888 (INIS-mf–12006, pp. 35-38) **β-NMR on ^{12}B implanted in metallic single crystals.** Diehl, E.; Dippel, R.; Ergezinger, K.H.; Fischer, B.; Ittermann, B.; Jaeger, E.; Metzner, H.; Seelinger, W.; Sulzer, G.; Ackermann, H. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

The β-NMR-technique has been used to determine lattice locations of ^{12}B implanted in single crystals. For the system ^{12}B in vanadium two different sites were investigated separately. The location of ^{12}B in Ni_3Al could be identified combining our results with existing channeling data. (orig.).

53889 (KEK–88-14) **Numerical tables of anomalous scattering factors calculated by the Cromer and Liberman's method.** Sasaki, Satoshi. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Feb 1989. 137p. Order Number DE90709957. Available from NTIS (US Sales Only), PC A07/MF A01.

Anomalous scattering factors f' and f" have been calculated for the atoms Li through Bi, plus U, using the relativistic treatment described by Cromer and Liberman. The final f' value does not include the Jensen's correction term on the magnetic scattering. The tables are presented with the f' and f" values (i) at 0.01 A intervals in the wavelength range from 0.1 to 2.89 A and (ii) at 0.0001 A intervals in the neighborhood of the K, L_1, L_2, and L_3 absorption edges. (author).

53890 (KURRI-TR–312, pp. 1-3) **Irradiation deffects on silicon with (D,T) neutrons.** Oshima, Ryuichiro (Osaka Univ., Toyonaka (Japan). Faculty of Engineering Science). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Feb 1989. (In Japanese). (CONF-8812110–: Specialist research meeting on semiconductors with research reactors, Kumatori (Japan), 12-13 Dec 1988). In *Proceedings of the specialist research meetings on semiconductors with research reactors.* Order Number DE90705930. Available from NTIS (US Sales Only), PC A07/MF A01.

Published in summary form only. SILICON/neutron beams; SILICON; IRRADIATION; PHYSICAL RADIATION EFFECTS; DEFECTS; POSITRON DETECTION; TEMPERATURE DEPENDENCE; LIFETIME; ANNEALING; D-T REACTORS; NEUTRONS; MEV RANGE 10-100

53891 (KURRI-TR–312, pp. 4-7) **Radiation deffects in Si.** Fukuoka, Noboru (Naruto Univ. of Education, Tokushima (Japan)). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Feb 1989. (In Japanese). (CONF-8812110–: Specialist research meeting on semiconductors with research reactors, Kumatori (Japan), 12-13 Dec 1988). In *Proceedings of the specialist research meetings on semiconductors with research reactors.* Order Number DE90705930. Available from NTIS (US Sales Only), PC A07/MF A01.

Published in summary form only. SILICON/crystal defects; SILICON; IRRADIATION; TEMPERATURE DEPENDENCE; ANNEALING; INFRARED SPECTRA; CARRIER DENSITY; PHOTOLUMINESCENCE; PHYSICAL RADIATION EFFECTS; ELECTRON BEAMS; NEUTRON BEAMS

53892 (KURRI-TR–312, pp. 8-17) **Diffusion of impurities in Si and its relation with point defects.** Yoshida, Masayuki (Kyushu Inst. of Design, Fukuoka (Japan)). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Feb 1989. (In Japanese). (CONF-8812110–: Specialist research meeting on semiconductors with research reactors, Kumatori (Japan), 12-13 Dec 1988). In *Proceedings of the specialist research meetings on semiconductors with research reactors.* Order Number DE90705930. Available from NTIS (US Sales Only), PC A07/MF A01.

Some topics on the diffusion of impurities in Si and its relations with point defects are discussed. Diffusion of impurities in Si is affected by such factors as the dislocation density, sample thickness and atmosphere, suggesting that defects are involved in the diffusion process. Oxidation stacking faults (OSFs) are produced in oxidized Si due to non-saturation with vacancies or supersaturation with interstitial Si. P and B diffuse faster in an oxidizing atmosphere than in a non-oxidizing atmosphere (oxidation enhanced diffusion: OED) due to supersaturation with point defects involved in their diffusion. The simultaneous occurrence of these processes indicates that the diffusion of P and B involves interstitial Si and proceeds by the interstitialcy mechanism, with the interstitial Si resulting from the oxidation. Compared to this, Sb diffuses more slowly in an oxidizing atmosphere than in a non-oxidizing atmosphere (oxidation retarded diffusion). Equations for the diffusion of vacancies and interstitial Si are derived and discussed. Some results of back-side OED and ORD are cited and discussed. It is insisted that some point defects are freezed when Si is quenched from a high temperature. Some methods for analyzing OED, ORD and OSF are briefly outlined. (N.K.).

53893 (KURRI-TR–312, pp. 55-58) **Irradiation effect on aluminum compounds.** Atobe, Kozo (Naruto Univ. of Education, Tokushima (Japan)). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Feb 1989. (In Japanese). (CONF-8812110–:

Specialist research meeting on semiconductors with research reactors, Kumatori (Japan), 12-13 Dec 1988). In *Proceedings of the specialist research meetings on semiconductors with research reactors.* Order Number DE90705930. Available from NTIS (US Sales Only), PC A07/MF A01.

As to the research on the irradiation damage of insulators, the research on the color center of alkali halide has been carried out for many years. Recently, the insulators which can be used under strong radiation condition have been demanded, and aluminium oxide is considered as one of the condidates. As the typical material, the material of low activation is taken in consideration, and the light elements like Al-Mg-O-N system are used. However, the basic research on the radiation damage of such material has not been sufficiently carried out. In the present experiment, the irradiation with fast neutrons was carried out on the samples of Al_2O_3, spinel ($MgO\text{-}3Al_2O_3$) and AlN, and the effect of irradiation was measured mainly by optical means. As the facilities for the irradiation, those which have the atmosphere of irradiation temperature at which irradiation defects are not annealed were used, and the irradiation atmosphere was helium gas. In Al_2O_3, the efficiency of forming point defects by neutron irradiation was largely different due to irradiation temperature. The recombination of defects and the conversion to compound defects occurred. In the case of spinel, only the absorption band due to F-centers appeared strongly. In AlN, also F-type defects arose. (K.I.).

53894 (KURRI-TR-312, pp. 59-67) **Process of optical excitation and relaxation of color center in synthetic diamond and its application to optoelectronics.** Nishida, Yoshio (Osaka Univ., Toyonaka (Japan). Faculty of Engineering Science). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Feb 1989. (In Japanese). (CONF-8812110--: Specialist research meeting on semiconductors with research reactors, Kumatori (Japan), 12-13 Dec 1988). In *Proceedings of the specialist research meetings on semiconductors with research reactors.* Order Number DE90705930. Available from NTIS (US Sales Only), PC A07/MF A01.

Irradiation of high-pressure synthesized diamond is carried out by using a nuclear reactor or a linac. Then, the effect of annealing on the color centers is observed. A study is made to identify different color centers and to provide techniques to control their introduction. Investigations cover the relation of color center formation with annealing temperature, dependence of color center formation on radiation dose, migration of H3 center and hydrogen, and applicability of five different color centers to optoelectronics. Next, a study is made of the formation and relaxation of the nitrogen vacancy (NV) center in a metastable excited state produced by optical excitation. An optical gain is essential to provide laser. Optical amplification is measured at the vibronic emission band of the NV center. An increase in absorption is detected, indicating that the NV center will not provide laser. In the optical excitation-relaxation process, the relaxation proceeds via a metastable state. Finally, hole burning of ZPL of the NV center is observed in the temperature range from 20K to 80K, and some of its features are described. (N.K.).

53895 (LA-UR-89-3094) **Dynamical properties from quantum Monte Carlo by the Maximum Entropy Method.** Silver, R.N.; Sivia, D.S.; Gubernatis, J.E. Los Alamos National Lab., NM (USA). [1989]. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-8908106--2: Los Alamos workshop on quantum simulations of condensed matter phenomena, Los Alamos, NM (USA), 8-11 Aug 1989). Order Number DE90001835. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An outstanding problem in the simulation of condensed matter phenomena is how to obtain dynamical information. We consider the numerical analytic continuation of imaginary time Quantum Monte Carlo data to obtain real frequency spectral functions. We suggest an image reconstruction approach which has been widely applied to data analysis in experimental research, the Maximum Entropy Method (MaxEnt). We report encouraging preliminary results for the Fano-Anderson model of an impurity state in a continuum. The incorporation of additional prior information, such as sum rules and asymptotic behavior, can be expected to significantly improve results. We also compare MaxEnt to alternative methods. 17 refs., 4 figs.

53896 (LA-UR-89-3175) **Optical solitons in liquid crystals.** Yung, Y.S.; Lam, L. Los Alamos National Lab., NM (USA). [1989]. 7p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. (CONF-8801171--1: Conference on solitons and chaotic behavior in optical systems, San Jose, CA (USA), 6-7 Jan 1988). Order Number DE90000694. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

In this paper, we will discuss theoretically the possible existence of optical solitons in the isotropic liquid and in the nematic phase. For the same compound, when heated, the nematic phase will go through a first order transition at temperature T_c to the isotropic liquid phase. As temperature increases from below T_c, the orientation order parameter, Q, decreases, drops to zero abruptly at T_c and remains zero for $T > T_c$. 10 refs., 1 fig.

53897 (LA-UR-89-3249) **General many-body systems.** Trugman, S.A. Los Alamos National Lab., NM (USA). [1989]. 27p. Sponsored by U.S. DOE Energy Research; National Aeronautics and Space Administration; National Science Foundation. DOE Contract W-7405-ENG-36. PHY82-17853. (CONF-8905225--1: NATO advanced summer school on applications of statistical and field theory to condensed matter, Evora (Portugal), May 1989). Order Number DE90000685. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The problem of how to visualize and sometimes solve a general many-body system is considered. The ideas are established in the context of very simple small systems, a Hubbard model and a coupled electron-phonon model, both on two lattice sites. These models are also solved to good approximation in the thermodynamic limit, although the Hubbard model is restricted to a small number of holes away from the Mott insulating state. Response functions are also considered. A fairly general many-body Hamiltonian is considered. It consists of an electron or other fermion kinetic energy and electron-electron interactions, which may be coupled to a bose field such as a phonon. The phonons themselves may be nonlinear (have self-interactions). The system may be strongly coupled. One may also add coupling to an external driving field, such as an ac electric field. The methods discussed are nonperturbative, and so differ from the standard methods of diagrammatic perturbation theory. A comparison is made with diagrammatic methods in the context of the random phase approximation. 6 refs., 12 figs.

53898 (LBL-27694) **Non-linear optical studies of adsorbates: Spectroscopy and dynamics.** Zhu, Xiangdong. Lawrence Berkeley Lab., CA (USA). Aug 1989. 178p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE90001543. Available from NTIS, PC A09/MF A01; OSTI; INIS; GPO Dep.

In the first part of this thesis, we have established a systematic procedure to apply the surface optical second-harmonic generation (SHG) technique to study surface dynamics of adsorbates. In particular, we have developed a novel technique for studies of molecular surface diffusions. In this technique, the laser-induced desorption with two interfering laser beams is used to produce a monolayer grating of adsorbates. The monolayer grating is detected with diffractions of optical SHG. By monitoring the first-order second-harmonic diffraction, we can follow the time evolution of the grating modulation from which we are able to deduce the diffusion constant of the adsorbates on the surface. We have successfully applied this technique to investigate the surface diffusion of CO on Ni(111). The unique advantages of this novel technique will enable us to readily study anisotropy of a surface diffusion with variable grating orientation, and to investigate diffusion processes of a large dynamic range with variable grating spacings. In the second part of this work, we demonstrate that optical infrared-visible sum-frequency generation (SFG) from surfaces can be used as a viable surface vibrational spectroscopic technique. We have successfully recorded the first vibrational spectrum of a monolayer of adsorbates using optical infrared-visible SFG. The qualitative and quantitative correlation of optical SFG with infrared absorption and Raman scattering spectroscopies are examined and experimentally demonstrated. We have further investigated the possibility to use transient infrared-visible SFG to probe vibrational transients and ultrafast relaxations on surfaces. 146 refs.

53899 (ORNL–6571) **Solid State Division: Progress report for period ending March 31, 1989.** Green, P.H.; Watson, D.M. (eds.). Oak Ridge National Lab., TN (USA). Aug 1989. 248p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90000979. Available from NTIS, PC A11/MF A01; OSTI; INIS; GPO Dep.

This report contains brief discussions on work done in the Solid State Division of Oak Ridge National Laboratory. The topics covered are: Theoretical Solid State Physics; Neutron scattering; Physical properties of materials; The synthesis and characterization of materials; Ion beam and laser processing; and Structure of solids and surfaces. (LSP)

53900 (ORNL/FTR–3021) **[Ion implantation of ceramics]: Foreign trip report, August 24–September 10, 1988.** Zinkle, S.J. Oak Ridge National Lab., TN (USA). 19 Sep 1988. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90001298. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler attended and presented a paper entitled "Ion Irradiation Studies of Oxide Ceramics" at the NATO Advanced Study Institute on Structure-Property Relationships in Surface-Modified Ceramics. An up-to-date assessment of the property and microstructural changes associated with ion implantation of ceramics was covered at the Institute through a series of invited and contributed papers.

53901 (ORNL/FTR–3384) **[Ion beam deposition research and development program]: Foreign trip report, July 28, 1989–September 17, 1989.** Alton, G.D. Oak Ridge National Lab., TN (USA). 2 Oct 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90001249. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This report provides a brief summary of the activities engaged in by the traveler while working as a guest scientist at the Harwell Laboratory, Oxfordshire, England. While at Harwell, the traveler initiated a research and development program designed to study the properties of films prepared by the direct deposition of epithermal ion beams of a variety of species (energies: 25 to 500 eV). To accomplish the objective, the traveler designed ion deposition lens systems for an existing circularly-symmetric low-beam-intensity facility and for a two-dimensional, slit-type, high-intensity facility under proposal. A lens for the low-beam-intensity facility was fabricated and used, preliminarily, to prepare thin carbon films. In addition to the projects related to ion beam deposition, the traveler made improvements to the filament lifetimes of the duoplasmatron used in conjunction with the low-beam-intensity system and advised on problems associated with negative ion sources on the 6-MV tandem accelerator.

53902 (RAL–89-046) **ATLAS - analysis of time-of-flight diffraction data from liquid and amorphous samples. Version 1.0.** Soper, A.K.; Howells, W.S.; Hannon, A.C. Rutherford Appleton Lab., Chilton (UK). May 1989. 130p. Order Number DE90605726. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

The purpose of this manual is to describe a package of data analysis routines which have been developed at the Rutherford Appleton Laboratory for the analysis of time-of-flight diffraction data from liquids, gases, and amorphous materials. There is no fundamental barrier to diffraction data being accurately analysed to structure factor or even pair correlation function within a very short time of the completion of the experiment. Section 1 describes the time-of-flight neutron diffraction experiment and looks at diffraction theory. Section 2 indicates the steps in data analysis of time-of-flight diffraction data and Section 3 gives details of how to run the procedures. (author).

53903 (RAL–89-057) **Application of the specular reflection of neutrons to the study of surfaces and interfaces.** Penfold, J.; Thomas, R.K. Rutherford Appleton Lab., Chilton (UK). Jun 1989. 72p. Order Number DE90605727. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

A range of phenomena analogous to those observed in classical optics are exhibited by slow neutrons; these include reflection, refraction and interference. Total reflection of slow neutrons has been extensively applied to a range of problems. The specular reflection of neutrons gives information on the neutron refractive index profile normal to an interface. The refractive index is simply related to the scattering length density and hence specular neutron reflection can provide important information about the composition of surfaces and interfaces. Neutrons scattering amplitudes vary randomly from element to element, and isotopic substitution can be used to produce large contrasts in the scattering density. Since some of the early experiments and applications it is only relatively recently that any concerted effort has been made to apply the technique to the wider study of surface and interfacial problems. The theoretical background is discussed, experimental methods described and recent examples of the use of this technique in surface chemistry, surface magnetism and solid films are given. (author).

53904 (SAND–89-0854C) **Near-threshold energy dependence of Xe-induced displacements on Ge(001).** Picraux, S.T.; Brice, D.K.; Horn, K.M.; Tsao, J.Y.; Chason, E. Sandia National Labs., Albuquerque, NM (USA). 1989. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract AC04-76DP00789. (CONF-890821–4: 13. international conference on atomic collisions in solids, Aarhus (Denmark), 7-11 Aug 1989). Order Number DE90001176. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Surface displacements due to low energy (100-300 eV) Xe ion bombardment of the Ge(001) 2×1 reconstructed surface are investigated by in situ RHEED measurements of surface roughening. The near-exponential decay in RHEED intensity due to displacements of Ge atoms at the surface is shown to depend sensitively on the Xe energy and flux. Iso-damage rate curves at 100°C are used to establish a fixed amount of defect annealing and to determine the number of surface displacements per Xe as a function of Xe energy. The calculated number of near-surface displacements per Xe exhibits a similar energy dependence. Comparison of experiment and calculation indicates an efficiency for the production of stable surface defects of about 50% at a temperature of 100°C and damage rate of 2×10^{12} displacements/cm^2-sec. Results indicate this approach will allow the threshold energies for surface atom displacements to be measured. 7 refs., 4 figs.

53905 **Advances in laser science–4: Proceedings.** Optical science and engineering series 10. Golf, J.L.; Heller, D.F.; Lapp, M.; Stwalley, W.C. (eds.). 777p. American Institute of Physics, New York, NY (USA) (1989). Sponsored by American Institute of Physics. (CONF-8810399–: 4. advances in laser science, Atlanta, GA (USA), Oct 1988).

This report contains papers on the following main topics: lasers and coherent sources, nonlinear optical phenomena and applications; condensed matter, surfaces, and particle spectroscopy with emphasis on laser-surface interactions; atomic, molecular, and ionic spectroscopy; state-specific photophysics and photochemistry; and diagnostic and analytical applications of lasers. Individual paper will be cataloged separately.

53906 **Control of etching of $LiNbO_3$ by implant damage profile tailoring.** Brannon, P.J. (Sandia National Labs., Albuquerque, NM (USA)); Ashby, C.I.H.; Arnold, G.W. vp of Laser and particle-beam chemical processing for microelectronics. Ehrlich, D.J.; Higashi, G.S.; Oprysko, M.M. Materials Research Society, Pittsburgh, PA (1988). (CONF-8711147–: Laser and particle-beam chemical processing for microelectronics, Boston, MA (USA), 30 Nov - 3 dec 1987).

Damage-profile tailoring using multi-energy ion implants can produce smooth side walls and deeper etched features with ion-bombardment-enhanced wet etching of $LiNbO_3$ than is possible with a single-energy implant. High ion fluences can produce buried microcracks which may contribute to propagation losses commonly observed in ion-implanted waveguides.

53907 **Electron microdiffraction and channeling: Theory and applications.** Kim, Y.O. Thesis (Ph. D.). 200p. Arizona State Univ., Tempe, AZ (US) (1988). Available from University Microfilms, PO Box 1764, Ann Arbor, MI 48106, Order No.88-15,614.

Three related topics in the theory of dynamical kilovolt electron diffraction are treated, and one practical application of the theory is provided. The first topic concerns the theory of coherent electron microdiffraction for atomic clusters and precipitates. The visibility of High Order Laue Zone (HOLZ) lines within the central-beam disk of

coherent electron-microdiffraction patterns was studied using dynamical electron-diffraction theory. The electron source size is also shown to affect HOLZ line visibility. Coherent electron-microdiffraction patterns were obtained from a new crystalline precipitate found in silicon wafers annealed at 635°C for 256 h. The most likely structure is that of keatite (SiO_2, tetragonal). The implications for the study of oxygen precipitation in silicon are discussed. The second theoretical topic concerns the possibilities for determining the sites of adatoms on surfaces by measurements of the x-ray or Auger electron yield as a function of diffraction conditions in the RHEED geometry. Finally, the effects of wave-function dimensionality and inelastic localization on ALCHEMI (Atom Location by Channeling Enhanced Microanalysis) has been studied. The original ALCHEMI equations are shown to hold for certain conditions.

53908 Interpretation of the linear coefficient of surface-plasmon dispersion. Feibelman, P.J. (Sandia National Laboratories, Albuquerque, New Mexico 87185 (US)). *Physical Review [Section] B: Condensed Matter (USA),* 40(5): 2752-2756 (15 Aug 1989). DOE Contract AC04-76DP00789.

Microscopic theory predicts that the fluctuating charge of free-electron-metal surface plasmons will lie in the tail of the metallic electron gas, and that, as a consequence, the linear coefficient of surface-plasmon dispersion will be negative. The latter prediction is interpreted here using the virial theorem. At larger wave vectors the more rapidly attenuating electric field associated with a fluctuating charge that lies outside the bulk of a metal will move fewer electrons. The virial theorem relates this fact to a lower frequency. Were the fluctuating charge to lie inside a metal, then more of its electric field would move electrons as the field attenuation became more rapid. This, according to the virial theorem, would imply a positive dispersion coefficient.

53909 Anisotropic tight-binding model for localization. Li, Q. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011 (US)); Soukoulis, C.M.; Economou, E.N.; Grest, G.S. *Physical Review [Section] B: Condensed Matter (USA),* 40(5): 2825-2830 (15 Aug 1989). DOE Contract W-7405-ENG-82.

The anisotropic tight-binding model, which is defined by a disordered tight-binding Hamiltonian with a transfer-energy-matrix element in the z direction, t, different than the one in the x-y plane is studied using finite-size scaling methods. The dependence of the mobility edge on the strength of anisotropy t ($0 \leq t \leq 1$) is obtained for the center of the band, E=0. Even for very low-t values an appreciable amount of disorder is needed to localize the E=0 state. These results are found to be in satisfactory agreement with the predictions of the potential-well analogy, coupled with the coherent-potential approximation.

53910 First-principles calculation of alloy phase diagrams: The renormalized-interaction approach. Ferreira, L.G. (Solar Energy Research Institute, Golden, Colorado 80401 (US)); Wei, S.; Zunger, A. *Physical Review [Section] B: Condensed Matter (USA),* 40(5): 3197-3231 (15 Aug 1989). DOE Contract AC02-77CH00178.

We present a formalism for calculating the temperature-composition phase diagrams of isostructural solid alloys from a microscopic theory of electronic interactions. *First*, the internal energy of the alloy is expanded in a series of volume-dependent multiatom interaction energies. These are determined from self-consistent total-energy calculations on periodic compounds described within the local-density formalism. *Second*, distant-neighbor interactions are renormalized into composition- and volume-dependent effective near-neighbor multisite interactions. *Finally*, approximate solutions to the general Ising model (using the tetrahedron cluster variation method) underlying these effective interactions provide the excess enthalpy ΔH, entropy ΔS, and hence the phase diagram. The method is illustrated for two prototype semiconductor fcc alloys: one with a large size mismatch ($GaAs_xSb_{1-x}$) and one with a small size mismatch ($Al_{1-x}Ga_xAs$), producing excellent agreement with the measured miscibility temperature and excess enthalpies. For lattice-mismatched systems, we find $0 < \Delta H^O < \Delta H^D$, where O denotes some ordered Landau-Lifshitz (LL) structures, and D denotes the disordered phase. We hence predict that such alloys will disproportionate at low-temperature equilibrium into the binary constituents, but if disproportionation is kinetically inhibited, some special ordered phases (i.e., chalcopyrite) will be thermodynamically stabler below a critical temperature than the disordered phase of the same composition. For the lattice-matched systems, we find $0 < \Delta H^O < \Delta H^O$ for all LL structures, so that only a phase-separating behavior is predicted.

53911 First-principles method for calculating electronic properties of layered structures. Rogers III, J.P. (Department of Metallurgical Engineering and Materials Science, Carnegie Mellon University, Pittsburgh, Pennsylvania 15213-3890 (US)); Nelson, J.S.; Cutler, P.H.; Feuchtwang, T.E. *Physical Review [Section] B: Condensed Matter (USA),* 40(6): 3638-3642 (15 Aug 1989).

We present a first-principles, computationally efficient method for calculating the electronic structure of layered systems consisting of simple metals. The method involves forming a one-dimensional, planar-averaged potential from a three-dimensional array of ionic pseudopotentials. As an example of its use, we have calculated the work function, electron density, and effective potential for ultrathin Na, K, and Li films. The calculations, which can be performed on a workstation, show good agreement with experimental results and three-dimensional, self-consistent-field pseudopotential calculations taking several hours of central-processing-unit time on a Cray Research, Inc. supercomputer.

53912 Lattice-dynamical calculation of the Kapitza resistance between fcc lattices. Young, D.A. (Department of Physics, Brown University, Providence, Rhode Island 02912 (US)); Maris, H.J. *Physical Review [Section] B: Condensed Matter (USA),* 40(6): 3685-3693 (15 Aug 1989).

The temperature dependence of the Kapitza resistance (thermal boundary resistance) at the interface between two dissimilar solids is calculated for a model system consisting of two semi-infinite, harmonic fcc lattices in register. The spectral density of phonon flux transmitted across the interface is obtained from a numerical calculation of the phonon transmission coefficient and group velocity and is used to calculate the Kapitza resistance. Results for the spectral density of the transmitted phonon flux, the spectral dependence of the phonon transmission coefficient, and the temperature dependence of the thermal boundary resistance are presented. Calculation of the thermal boundary resistance for real systems using the results of this calculation is discussed.

53913 Real-space multiple-scattering theory and the electronic structure of systems with full or reduced symmetry. Zhang, X. (Department of Physics and Astronomy, Northwestern University, Evanston, Illinois 60201 (US)); Gonis, A.; MacLaren, J.M. *Physical Review [Section] B: Condensed Matter (USA),* 40(6): 3694-3710 (15 Aug 1989). DOE Contract W-7405-ENG-48.

We present a new real-space multiple-scattering-theory method for the solution of the Schrödinger equation and the calculation of the electronic structure of solid materials with full or reduced symmetry. The method is based on the concept of semi-infinite periodicity (SIP), rather than translational invariance, and on the property of removal invariance of the scattering matrix of systems with SIP. This latter property allows one to replace the usual Brillouin-zone integrals in reciprocal space by a self-consistency equation for the t matrix, which is sufficient for the determination of the Green function and related properties. Because it is developed entirely in direct space, the method provides a unified treatment of the electronic structure of bulk materials, surfaces, interfaces and grain boundaries (coherent or incoherent), impurities of interstitial or substitutional kinds, and can be easily extended to treat concentrated, substitutionally disordered alloys. One of its advantages over methods based on Bloch's theorem and reciprocal space is the great simplicity of setting up and running the associated computer codes even for complex structures, and structures with reduced or no symmetry that lie outside the realm of applicability of conventional methods. We present the results of model calculations for one-dimensional and three-dimensional model systems as well as for three-dimensional realistic materials. Where appropriate, these results are compared with those obtained through conventional techniques, and give an indication of the method's flexibility and reliability. Our applications of this method to this point are discussed, and our plans for future development are presented.

53914 **Ma-Brueckner correlation energy.** Kleinman, L. (Department of Physics, University of Texas, Austin, Texas 78712 (US)); Tamura, T. *Physical Review [Section] B: Condensed Matter (USA),* 40(6): 4191-4193 (15 Aug 1989).

We point out that the e^2 dependence of the term in the correlation energy of a high-density electron gas, proportional to the gradient squared of the charge density, was rigorously derived by Ma and Brueckner only for infinitely long-wavelength variations in the charge density. We also correct an error made in obtaining the coefficient of this term which arose because of long-range Coulomb anomalies in the exchange energy which they subtracted from the exchange-correlation energy.

53915 **The influence of an external electric field on the X-ray scattering of 2-methyl-4-nitroaniline, an organic crystal with nonlinear optical properties.** Paturle, A. (State Univ. of New York, Buffalo (USA). Dept. of Chemistry); Graafsma, H.; Boviatsis, J.; Legrand, A.; Restori, R.; Coppens, P.; Kvick, A.; Wing, R.M. *Acta Crystallographica, Section A: Foundations of Crystallography (Denmark),* 45(6): FC25-FC28 (1 Jun 1989). DOE Contract FG02-86ER45231;AC02-76CH00016.

The influence of an electric field on the X-ray scattering of the nonlinear optical organic crystal MNA (2-methyl-4-nitroaniline) has been studied, using a three-step pulsed alternating electric field. The field changes are synchronized with the gating to three different counting chains (the three-step modulation method). A field strength of 39 kV cm^{-1} induces 0.2% maximum variation in the integrated intensity and a small shift in Bragg angles (an inverse piezoelectric effect). A special electron density refinement method, which uses the differences between the zero- and applied-field intensities as observations, has been developed and applied in the interpretation of the results. (orig.).

6561 Superconductivity

Refer also to citation(s) 51959, 52533, 52610, 52631, 52632, 52877, 53654, 53886

53916 (ORNL/FTR–3014) **[Theoretical studies on high-temperature superconductivity]: Foreign trip report, August 29, 1987–August 20, 1988.** Stocks, G.M. Oak Ridge National Lab., TN (USA). 5 Sep 1988. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90001297. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report covers a one-year assignment to the University of Bristol. While at Bristol I worked on the calculation of the electronic structure and ground state properties of the new class of high-temperature superconducting materials. I also worked on the development of a new code to calculate the electronic structure and ground state properties of disordered systems (alloys, nonstoichiometric, and alloyed high-temperature superconducting materials) that have more than one atom per unit cell. I also initiated work to study the possibility of obtaining superconductivity within the Hubbard model.

53917 **Kim model for magnetization of type-II superconductors.** Chen, D. (Electromagnetic Technology Division, National Institute of Standards and Technology, Boulder, Colorado 80303 (US)); Goldfarb, R.B. *Journal of Applied Physics (USA),* 66(6): 2489-2500 (15 Sep 1989).

We have calculated the initial magnetization curves and complete hysteresis loops for hard type-II superconductors. The critical-current density J_c is assumed to be a function of the internal magnetic field H_i according to Kim's model, $J_c(H_i)=k/(H_0+|H_i|)$, where k and H_0 are constants. As is the case for other critical-state models, additional assumptions are that bulk supercurrent densities are equal to J_c, and that the lower critical field is zero. Our analytic solution is for an infinite orthorhombic specimen with finite rectangular cross section, $2a\times2b$ ($a\leq b$), in which a uniform field H is applied parallel to the infinite axis. Assuming equal flux penetration from the sides, we reduced the two-dimensional problem to a one-dimensional calculation. The calculated curves are functions of b/a, a dimensionless parameter $p=(2ka)^{1/2}/H_0$, and the maximum applied field H_m. The field for full penetration is $H_p=H_0[(1+p^2)^{1/2}-1]$. A related parameter is $H^*_m=H_0[(1+2p^2)^{1/2}-1]$. Hysteresis loops were calculated for the different ranges of H_m : $H_m<H_p$, $H_p<H_m<H^*_m$, and $H^*_m<H_m$. The equations for an infinite cylindrical specimen of radius a are the same as those for a specimen with square cross section, $a=b$.

6570 Theoretical and Mathematical Physics

Refer also to citation(s) 52918, 53664, 53690, 53718, 53895

53918 (CNIC–00207) **Comments on 'exactly solvable models and new link polynomials'.** Ma Zhongqi. China Nuclear Information Centre, Beijing, BJ (China). Jun 1988. 4p. Order Number DE90602935. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Recently, Akutsu and Wadati made a new development in the mathematical theory on knots and links, that is , they found out new link polynomials for knots and links in terms of the solutions of the exactly solvable vertex models in two dimensional statistical systems at criticality. In this note, some definitions are modified more accurately in order to make the theory more perfect.

53919 (INIS-mf–12006, pp. 113) **Dyson's correlation functions.** Guhr, T. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Published in summary form only. QUANTUM MECHANICS/ stochastic processes; MANY-DIMENSIONAL CALCULATIONS; MATRICES; GAUSSIAN PROCESSES; RANDOMNESS; CORRELATION FUNCTIONS; HAMILTONIANS; FLUCTUATIONS; GRADED LIE GROUPS; ENERGY SPECTRA; SYMMETRY; EIGENVALUES; INTEGRALS

53920 (INIS-mf–12006, pp. 114) **Quantization of non-integrable systems.** Wintgen, D. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). Contract DFG Wi 877/2;DFG Wi 877/3. In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Published in summary form only. QUANTUM MECHANICS/ stochastic processes; NONLINEAR PROBLEMS; QUANTIZATION; SCHROEDINGER EQUATION; SEMICLASSICAL APPROXIMATION; FLUCTUATIONS; DISTURBANCES; ORBITS; TRAJECTORIES; ELECTROMAGNETIC FIELDS; ATOMS

53921 (ISN–89-19) **Second RPA dynamics at finite temperature: time-evolutions of dynamical operators.** Jang, S. Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires. Jan 1989. 46p. Order Number DE90713763. Available from NTIS (US Sales Only), PC A03/MF A01.

Time-evolutions of dynamical operators, in particular the generalized density matrix comprising both diagonal and off-diagonal elements, are investigated within the framework of second RPA dynamics at finite temperature. The calculation of the density matrix previously carried out through the appliance of the second RPA master equation by retaining only the slowly oscillating coupling terms is extended to include in the interaction Hamiltonian both the rapidly and slowly oscillating coupling terms. The extended second RPA master equation, thereby formulated without making use of the so-called resonant approximation, is analytically solved and a closed expression for the generalized density matrix is extracted. We provide illustrative examples of the generalized density matrix for various specific initial conditions. We turn particularly our attention to the Poisson distribution type of initial condition for which we deduce specifically a particular form of the density matrix from the solution of the Fokker-Planck equation for the coherent state representation. The relation of the Fokker-Planck equation to the second RPA master equation and its properties are briefly discussed. The oversight incurred in the time-evolution of operators by the resonant approximation is elucidated. The first and second moments of collective coordinates are also computed in relation to the expectation value of various dynamical operators involved in the extended master equation.

53922 (LAPP-TH–224-88) **Ward identities for conformal models.** Lazzarini, S.; Stora, R. Grenoble-1 Univ., 74 - Annecy

(France). Lab. de Physique des Particules. 1988. 4p. (CONF-8802155–: 4. Meeting between French and German Physicists and Mathematicians, Marseille (France), 29 Feb - 4 mar 1988). Order Number DE90713787. Available from NTIS (US Sales Only), PC A02/MF A01.

Ward identities which express the symmetry of conformal models are treated. Diffeomorphism invariance or locally holomorphic coordinate transformations are used. Diffeomorphism invariance is then understood in terms of Riemannian geometry. Two different sets of Ward identities expressing diffeomorphism invariance in a conformally invariant way are found for the free bosonic string. Using a geometrical argument, the correct invariance for a large class of conformal models is given.

53923 (LA-UR–89-1664) **Chaotic behavior in nonlinear polarization dynamics.** David, D.; Holm, D.D.; Tratnik, M.V. Los Alamos National Lab., NM (USA). [1989]. 24p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-891151–1: Nearly integrable systems and applications, Minneapolis, MN (USA), 7-11 Nov 1989). Order Number DE89013453. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We analyze the problem of two counterpropagating optical laser beams in a slightly nonlinear medium from the point of view of Hamiltonian systems; the one-beam subproblem is also investigated as a special case. We are interested in these systems as integrable dynamical systems which undergo chaotic behavior under various types of perturbations. The phase space for the two-beam problem is $C^2 \times C^2$ when we restricted the the regime of travelling-wave solutions. We use the method of reduction for Hamiltonian systems invariant under one-parameter symmetry groups to demonstrate that the phase space reduces to the two-sphere S^2 and is therefore completely integrable. The phase portraits of the system are classified and we also determine the bifurcations that modify these portraits; some new degenerate bifurcations are presented in this context. Finally, we introduce various physically relevant perturbations and use the Melnikov method to prove that horseshoe chaos and Arnold diffusion occur as consequences of these perturbations. 10 refs., 7 figs., 1 tab.

53924 Reduction of a wave packet in quantum Brownian motion. Unruh, W.G. (Canadian Institute for Advanced Research, Cosmology Program, Department of Physics, University of British Columbia, Vancouver, British Columbia, Canada V6T 1W5 (CA)); Zurek, W.H. *Physical Review [Section] D: Particles and Fields (USA),* 40(4): 1071-1094 (15 Aug 1989).

The effect of the environment on a quantum system is studied on an exactly solvable model: a harmonic oscillator interacting with a one-dimensional massless scalar field. We show that in an open quantum system, dissipation can cause decorrelation on a time scale significantly shorter than the relaxation time which characterizes the approach of the system to thermodynamic equilibrium. In particular, we demonstrate that the density matrix decays rapidly toward a mixture of "approximate eigenstates" of the "pointer observable," which commutes with the system-environment interaction Hamiltonian. This observable can be regarded as continuously, if inaccurately, monitored by the scalar field environment. Both because in a harmonic oscillator the state of the system rotates in the phase space and because the effective environment "measurement" is weak, the system, on the short "collision" time scale ($1/\Gamma$), maintains a coherence in this pointer observable on time scales of order $[\gamma/\Omega \ln(\Gamma/\Omega)]^{1/2}$ and on longer time scales settles into a mixture of coherent states with a dispersion approximately consistent with the vacuum state. The master equation satisfied by the exact solution differs from the other master equations derived both for the high-temperature limit and for $T=0$. We discuss these differences and study the transition region between the high- and low-temperature regimes. We also consider the behavior of the system in the short-time "transient" regime. For $T=0$, we find that, in the long-time limit, the system behaves as if it were subject to "1/*f* noise." The generality of our model is considered and its predictions are compared with previous treatments of related problems. Some of the possible applications of the results to experimentally realizable situations are outlined.

53925 Steady-state and transient eddy current predictions using surface impedances in shell structures. Davey, K. (School of Electrical Engineering, Georgia Institute of Technology, Atlanta, Georgia 30332-0250 (US)); Turner, L. *Journal of Applied Physics (USA),* 66(6): 2501-2507 (15 Sep 1989).

Surface impedance techniques are useful means of predicting fields in eddy current problems since they circumvent the need to model the conducting regions themselves. Thus, with their use, two- and three-dimensional field predictions can be made using only scalar potentials. Their use is normally confined to (1) problems where the skin depth is small relative to the other dimensions of the problem and (2) steady-state problems where the skin depth itself is well defined. In this regard, the technique is approximate at best. Presented here is a formulation which can realize an exact prediction of the field, both in steady-state and transient problems. The technique is exact for those problems where knowledge is known as to the nature of the field variation tangential to the conductor shell interface; otherwise, an iterative numerical scheme must be employed to converge on the correct tangential variation. Surface impedances are determined generically and expressed in terms of transfer functions for shell-type structures in three different geometries. The surface impedances happen to be trigometric functions, Bessel functions, and spherical Bessel functions in planar, cylindrical, and spherical shell structures, respectively. Their use is easily implemented in finite difference, finite element, and boundary integral formulations; in this paper, the surface impedances are coupled into a boundary integral approach to verify their use in both two-dimensional cylindrical and a three-dimensional spherical problem. The results are compared to analytical expressions and are shown to disagree by no more than 0.01%.

70 FUSION ENERGY

53926 (ORNL/FTR–3413) **[Penetration of charged particles in matter]: Foreign trip report, September 1, 1989–September 28, 1989.** Ritchie, R.H. Oak Ridge National Lab., TN (USA). 12 Oct 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90001592. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This report covers the activities of the traveler while attending The 12th Werner Brandt International Conference on the Penetration of Charged Particles in Matter held in San Sebastian, Spain, on September 4-7, 1989. The traveler participated in the workshop, interacted with scientists from Spain, Japan, and other countries, and took part in new and continuing collaborations. An important development was reported for the first time anywhere concerning anomalously high events for collision-induced fusion by clusters of heavy water on heavy water-saturated targets. The traveler devised a theoretical model to explain these results. Collaborative work on a monograph with two Spanish colleagues was carried out.

53927 (UCID–21809) **LLNL [Lawrence Livermore National Laboratory] research on cold fusion.** Thomassen, K.I.; Holzrichter, J.F. (eds.). Lawrence Livermore National Lab., CA (USA). 14 Sep 1989. 70p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90000930. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

With the appearance of reports on "Cold Fusion," scientists at the Lawrence Livermore National Laboratory (LLNL) began a series of increasingly sophisticated experiments and calculations to explain these phenomena. These experiments can be categorized as follows: (a) simple experiments to replicate the Utah results, (b) more sophisticated experiments to place lower bounds on the generation of heat and production of nuclear products, (c) a collaboration with Texas A&M University to analyze electrodes and electrolytes for fusion by-products in a cell producing 10% excess heat (we found no by-products), and (d) attempts to replicate the Frascati experiment that first found neutron bursts when high-pressure deuterium gas in a cylinder with Ti chips was temperature-cycled. We failed in categories (a) and (b) to replicate either the Pons/Fleischmann or the Jones phenomena. We have seen phenomena similar to the Frascati results, (d) but these low-level burst signals may not be coming

from neutrons generated in the Ti chips. Summaries of our experiments are described in Section II, as is a theoretical effort based on cosmic ray muons to describe low-level neutron production. Details of the experimental groups' work are contained in the six appendices. At LLNL, independent teams were spontaneously formed in response to the early announcements on cold fusion. This report's format follows this organization.

7001 Plasma Research

Refer also to citation(s) 52981, 52982, 53132, 53588, 53625, 53657, 53659, 53662, 53905, 54003, 54016

53928 (CNIC–00206) **Multijunction grill and its application on lower hybrid current drive experiments.** Jiang Tongwen; Liu Yuexiu; Wu Guiping; Zhang Xuelei. China Nuclear Information Centre, Beijing, BJ (China). May 1988. 8p. Order Number DE90603238. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

A new kind of lower hybrid wave launching structing-multijunction grill has been developed. In this new launcher the RF power is divided by means of an E-plane of rectangle waveguid and the phase difference of adjacent is obtained by a suitable length of the dielectric teflon inserted into corresponding waveguides. Lower hybrid current drive experiments have been successfully performed in HT-6M Tokamak with this multijunction grill. A driven efficiency eta_{CD} up to 0.55 ($10^{13}cm^{-3}$ center dotmcenter dotkA/kW) has been obtained. The influence of LHCD on MHD behaviour of plasma has been clearly observed too, though the RF power coupled to plasma is very low.

53929 (CONF-891007–13) **Transport studies of compact torsatron reactors.** Painter, S.L.; Lyon, J.F. Oak Ridge National Lab., TN (USA). 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 13. international symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. Order Number DE90001353. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

An efficient transport survey code utilizing the spectral collocation method was developed and is being used to study ignition in low-aspect-ratio torsatron reactors. Using a transport model dominated by helical-ripple-induced neoclassical heat fluxes, it is shown that ignition is possible for a range of radial electric fields and plasma aspect ratios even when the loss of trapped alpha particles is considered. However, control of the density profile near the plasma boundary is necessary. The sensitivity of the results to anomalous electron transport is also considered. Some initial investigations on the role played by "off-diagonal" terms in the neoclassical transport matrix in determining reactor performance are also presented, and a potentially attractive operating regime is found when these additional terms are considered. 9 refs., 5 figs.

53930 (DOE/ER/52127–60) **CTR plasma engineering studies: Annual progress report, December 1, 1988–November 30, 1989.** Miley, G.H. Illinois Univ., Urbana, IL (USA). Fusion Studies Lab. [1989]. 123p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-86ER52127. Order Number DE90001226. Available from NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.

This report discusses the following topics: ash control in tokamak plasma using induced fishbones; application of controlled sawtooth operation to ash control; and high energy ion transport.

53931 (DOE/ER/53223–113) **Plasma properties: Annual report, January 1, 1988–December 31, 1988.** Weitzner, H. New York Univ., NY (USA). Magneto-Fluid Dynamics Div. Aug 1989. 33p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-86ER53223. Order Number DE90001113. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A cursory examination of the research activities of the Magneto-Fluid Dynamics Division for the calendar year 1988 shows the effects of the gradual transformation of the group. Although our principal activity, fusion plasma physics research, is unchanged, the work shows closer ties to problems relevant to present experiments than previously. Most notable is the concentrated effort on tokamak equilibrium and transport. We are exploring the implication of turbulence induced transport, resistive MHD effects, neoclassical transport, and possible interpretations of transport based on classical phenomena. In addition, one of our members has chosen to focus on problems of enhanced statistical methods for interpretation of experiments. All of this activity preceded the Tokamak Transport Initiative and reflects our active involvement and concern with the world-wide tokamak program. Since equilibrium and transport are by no means the only theoretical plasma physics problems affecting fusion devices we continue substantial efforts in wave propagation and heating, particle simulation of plasmas, stability theory, enhancement of numerical algorithms, and general plasma physics. We are attempting to develop effective numerical schemes for the Boltzmann equation, adaptive grid methods for MHD, and particle simulation of boundary and antenna effects. Many of these topics reflect our continuing concern to maintain a modest effort in the development of theoretical models and tools for problems of real significance to fusion, but not necessarily of immediate highest priority. We select problems which we expect to become extremely important in the future. Our space plasma physics activities, funded by agencies other than DOE, transfers knowledge learned in fusion plasma physics to another area and conversely stimulates work also relevant to fusion problems.

53932 (DOE/ET/51013–275) **Ion collection by probing objects in flowing magnetized plasmas.** Kyu-Sun, Chung. Massachusetts Inst. of Tech., Cambridge, MA (USA). Plasma Fusion Center. Apr 1989. 196p. Sponsored by U.S. DOE Energy Research; Korea Science and Engineering Foundation. DOE Contract AC02-78ET51013. (PFC/RR–89-13). Order Number DE90001711. Available from NTIS, PC A09/MF A01; OSTI; INIS; GPO Dep.

A new one-dimensional collisionless kinetic model is developed for the flow of ions to probing structures in drifting plasmas. The cross-field flow into the presheath is modelled by accounting consistently for particle exchange between the collection flux tube and the outer plasma. Numerical solutions of the self-consistent plasma/sheath equations are obtained with arbitrary external ion temperature and parallel plasma flow velocity. Results are presented of the spatial dependence of the ion distribution function as well as its moments (density, particle flux, temperature, and power flux). The ion current to the probe is obtained and the ratio of the upstream to downstream currents is found to be well represented by the form $R = \exp[Ku_d]$, where $K = 1.66$ for $T_i = T_e$ and u_d is the drift velocity in units of $(T_e/m_i)^{1/2}$. The results agree well with comparable recent fluid calculations but show substantial deviations from other models which ignore particle exchange out of the presheath. No evidence is found of the formation of shocks in the downstream wake, contrary to the implications of some fluid theories. We have also extended the previous kinetic model by generalizing cross-field transport and adding ionization to the source of the Boltzmann equation along the presheath. Ion sheath current density and ratio(R) of upstream to downstream current are obtained as a function of plasma drift velocity, equivalent viscosity, ion temperature, and ionization rate. Constants(K) in the form $R = \exp[Ku_d]$ are obtained in terms of viscosity, ion temperature, and ionization rate. The effect of an electrical bias applied to the object on the presheath characteristics is discussed.

53933 (ESA-SP–285-VOL-1, pp. 385-389) **Simulation of electrostatic ion instabilities in the presence of parallel currents and transverse electric fields.** Nishikawa, K.I. (Naval Research Lab., Washington, DC (USA)); Ganguli, G.; Lee, Y.C.; Palmadesso, P.J. European Space Agency, 75 - Paris (France). Jan 1989. (ETN–89-94475;CONF-8809173–: International workshop on reconnection in space plasma, Potsdam (German Democratic Republic), 5-9 Sep 1988). In *Proceedings of an International School and Workshop on Plasma Astrophysics, volume 1.* Available from NTIS, PC A18/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 45 US dollars or 80 Dutch guilders.

A spatially two-dimensional electrostatic PIC simulation code was used to study the stability of a plasma equilibrium characterized by a localized transverse dc electric field and a field-aligned drift for L is much less than Lx, where Lx is the simulation length in the x direction and L is the scale length associated with the dc electric field. It is found that the dc electric field and the field-aligned current can together play a synergistic role to enable the excitation of electrostatic waves even when the threshold values of the field aligned

drift and the E x B drift are individually subcritical. The simulation results show that the growing ion waves are associated with small vortices in the linear stage, which evolve to the nonlinear stage dominated by larger vortices with lower frequencies.

53934 (ESA-SP–285-VOL-2, pp. 55-60) **Magnetic reconnection simulation using the 2.5 D electromagnetic direct implicit code AVANTI.** Hewett, D.W.; Francis, G.E.; Max, C.E. European Space Agency, 75 - Paris (France). Jan 1989. (ETN–89-94476;CONF-8809173–: International workshop on reconnection in space plasma, Potsdam (German Democratic Republic), 5-9 Sep 1988). In *Proceedings of an International School and Workshop on Reconnection in Space Plasma, volume 2.* Available from NTIS, PC A15/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 45 US dollars or 80 Dutch guilders.

The 2.5 D electromagnetic code AVANTI is outlined. The code runs stably with arbitrarily large Delta t and is quite robust with respect to large fluctuations occurring due to small numbers of particles per cell. The code shows that the reconnection process occurs in distinct stages: (1) early spontaneous reconnection fed by the free energy of an initial anisotropy in the electron component; (2) coalescence of the resulting small-scale filaments of electron current, accompanied by electron jetting; and (3) oscillatory flow of electrons through the magnetic X-point, superposed on continuing nonlinear growth of ion-mediated reconnection. The time evolution of stage 3 is strongly dependent on Mi/Me.

53935 (ESA-SP–285-VOL-2, pp. 61-66) **Kinetic simulation of magnetic reconnection in the presence of shear.** Francis, G.E.; Hewett, D.W.; Max, C.E. European Space Agency, 75 - Paris (France). Jan 1989. (ETN–89-94476;CONF-8809173–: International workshop on reconnection in space plasma, Potsdam (German Democratic Republic), 5-9 Sep 1988). In *Proceedings of an International School and Workshop on Reconnection in Space Plasma, volume 2.* Available from NTIS, PC A15/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 45 US dollars or 80 Dutch guilders.

The basic physical processes associated with collisionless magnetic reconnection are investigated using the implicit PIC code AVANTI. The code is based on a 2.5-D fully electromagnetic direct implicit algorithm which proved stable for arbitrary time step. This stability makes it possible to separate out the respective roles of the highly magnetized electron and the unmagnetized ions for large ion-electron mass ratios. It is found that the inclusion of a guide magnetic field (magnetic shear) severely slows the initial stages of reconnection and damps out the electrostatic ringing if local values of the guide field are above a threshold determined by questions of electron mobility.

53936 (GA-A–19546) **Assessment of possible high-energy neutral beam injection in DIII-D.** Bhadra, D.K.; Kim, J. General Atomics, San Diego, CA (USA). Oct 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-89ER51114. (CONF-891007–18: 13. international symposium on fusion engineering, Knoxville, TN (USA), 2-6 Oct 1989). Order Number DE90001654. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The feasibility of injecting high energy neutral particle beam in the DIII-D tokamak is examined. From numerical calculations of beam deposition, beam losses, and current drive, it is concluded that neutral beam injection up to an energy of 300 to 500 keV is viable. The effect of multistep excitation processes on the enhancement of the ionization cross-section of the energetic neutral particles works out to be beneficial for such a possible experiment. The knowledge obtained from such experiments would be essential for design, planning, and success for future large tokamak devices that will employ negative-ion based, high energy neutral beam injectors. 5 refs., 7 figs., 1 tab.

53937 (GA-A–19826) **Neoclassical transport induced by ICRF [ion-cyclotron range of frequencies] in the collisional regime.** Chiu, S.C.; Chan, V.S. General Atomics Co., San Diego, CA (USA). Sep 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-89ER53277. (CONF-8910225–1: IAEA technical committee meeting on ICRH/edge physics, Munich (Germany, F.R.), 2-5 Oct 1989). Order Number DE90000755. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

From the gyrokinetic equations, a quasilinear equation can be derived with rf effects included in the quasilinear operator. From this, generalized moment equations can be deduced in the guiding center approximation. Of particular interest is the parallel momentum equation which drives the neoclassical transport. The parallel rf forces which can be due to nonresonant or resonant ponderomotive forces are quite different between electrons and ions so that an electrostatic electric field is established. This electric field can influence transport near the plasma edge. We estimate the neoclassical particle and energy fluxes in the Pfirsch-Schlueter regime appropriate for the edge region. Since rf can generate asymmetric momentum and heat sources, it changes the transport in rf heated plasmas and also offers the possibility of externally controlling the density and confinement properties of a tokamak plasma. These effects are discussed in terms of antenna near fields and power requirements. Effects on limiter and divertor discharges will be discussed. 15 refs., 1 fig.

53938 (GTFR–92) **Evaluation of different control methods for the thermal stability of ITER [International Thermonuclear Experimental Reactor].** Mandrekas, J.; Stacey, W.M. Georgia Inst. of Tech., Atlanta, GA (USA). Sep 1989. 45p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-87ER52141. Order Number DE90001580. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A 0-D, time-dependent, particle and power balance code has been developed and used to evaluate the effectiveness of different burn control methods for the stabilization of unstable ignited and sub-ignited operating points of the ITER Physics Phase machine. Based on the results of our calculations, we conclude that operation of ITER at thermally unstable operating points is physically and technologically feasible. Control with auxiliary power modulation seems to be the method of choice for the control of sub-ignited unstable points, while other methods such as modulation of the fueling rate and high-Z impurity injection can also be used, specially for the control of unstable ignited points where auxiliary power modulation cannot be used. 41 refs., 18 figs., 4 tabs.

53939 (IPP–6/278) **Radiofrequency plasma heating and current drive.** Canobbio, E.; Croci, R. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.). Nov 1988. 70p. Available from Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.).

The mechanisms underlying radiofrequency plasma heating and current drive in closed configurations are considered together with the theoretical tools describing them, with just a brief mention of the actual experiments. The heating schemes of interest for thermonuclear devices span a wide range of frequencies form the Alfven wave resonance to the ion-cyclotron, lower hybrid and electron-cyclotron resonances. Heating at frequencies below the Alfven wave resonance (magnetic pumping in its numerous versions), which is of limited thermonuclear relevance, is presented for its fundamental aspects - more than any other heating scheme it involves properties of particle motion in the large which are specific to the magnetic traps - in order to provide a broader and more integrated view of the whole subject. (orig./AH).

53940 (IPPJ–905) **Extension of stellarator approximation in magnetohydrodynamic equilibrium and stability of toroidal helical systems.** Todoroki, Jiro. Nagoya Univ. (Japan). Inst. of Plasma Physics. Apr 1989. 33p. Order Number DE90709986. Available from NTIS (US Sales Only), PC A03/MF A01.

Formulation is made to solve three dimensional MHD equilibrium problem on the basis of the coordinate transformation. The three dimensional problem is divided into three steps: (1) the hyperbolic equations to determine the coordinate transformation, (2) averaged equation in two dimension, and (3) the three dimensional elliptic equation to deal with magnetic potential. The usual stellarator approximation or averaging method is regarded as the first step of the iteration procedure to get the solution of the full three dimensional problems. In formulating linear stability problem, the stellarator ordering is required; the resonance effect should be omitted in the averaging formulation. Some comparison is made to check the validity of the above formulation. (author).

53941 (IPPJ–906) **Role of edge magnetic shear on the limiter H-mode transition of the JIPP T-IIU tokamak.** Toi, K.;

Kawahata, K.; Morita, S. and others. Nagoya Univ. (Japan). Inst. of Plasma Physics. Apr 1989. 16p. Order Number DE90709985. Available from NTIS (US Sales Only), PC A03/MF A01.

In a circular cross-section plasma bounded by a limiter, the H-mode transition is triggered by rapid ramp-down in a plasma current during additional heating, even in the case that the edge electron temperature decays gradually prior to the transition. This result suggests that the enhancement of a magnetic shear near the plasma edge by the ramp-down plays a crucial role on the transition, and that the transition in a limiter-bounded plasma is essentially governed by the current density profile near the edge. (author).

53942 (IPPJ–907) **ECH plasma for different magnetic axis positions and initial ICRF plasma production experiments in CHS.** Okamura, S.; Fujiwara, M.; Hosokawa, M. and others. Nagoya Univ. (Japan). Inst. of Plasma Physics. Apr 1989. 22p. Order Number DE90709984. Available from NTIS (US Sales Only), PC A03/MF A01.

Electron cyclotron heating (ECH) experiments were performed in Compact Helical System (CHS) for three typical magnetic field configurations which correspond to different magnetic axis positions. The obtained electron temperatures are different for these configurations as well as the shapes of temperature and density profiles. The inward shifted configuration was better in that both the central temperature and the total energy are higher than the outward shifted case. ICRF heating with the Type-III antenna and/or the poloidal antenna produced a plasma for wide range of magnetic field strength. (author).

53943 (IPPJ–908) **Experimental study on the deposition profile of the ICRF power and electron thermal diffusivity.** Ogawa, Y.; Ando, R.; Kako, E. and others. Nagoya Univ. (Japan). Inst. of Plasma Physics. Apr 1989. 26p. Order Number DE90709983. Available from NTIS (US Sales Only), PC A03/MF A01.

IN ICRF heating experiments the deposition profile in electrons has been derived experimentally, and comparison with theory has been performed. It is found that the deposition profile is relatively broad ($P_{rf,e}(r) = P_{rf,e}(0)(1-(r/a)^2)^k$ with k = 1.8), and this is interpreted in terms of characteristics of the mode-converted Ion Bernstein Wave. The distribution of the rf power to each species (electrons, hydrogen and deuterium ions) is in good agreement with theoretical predictions. With the deposition profile experimentally obtained, the electron thermal diffusivity x_e has been calculated, resulting in $x_e \sim 0.65$ m^2/s at n-bar$_e$ = 9 x 10^{19} m^{-3}. (author).

53944 (IPPJ–909) **Improved confinement regimes in JIPP T-IIU.** Watari, T.; Kumazawa, R.; Toi, K. and others. Nagoya Univ. (Japan). Inst. of Plasma Physics. Apr 1989. 40p. Order Number DE90709988. Available from NTIS (US Sales Only), PC A03/MF A01.

The H-mode, an improved confinement regime, has been observed recently in JIPP T-IIU high power heating experiments. It was obtained in a limiter configuration without any shaping of the plasma cross-section. This H-mode is not common because it is obtained with ICRF heating. The H-mode is also obtained in a combined heating with NBI and ICRF and it is found that the threshold power level is similar to that of averaged ICRF heating. The power threshold of the H-mode is then studied for its dependence on various plasma parameters: It increases with plasma current, insensitive to plasma density, and optimized against toroidal field intensity. The power deposition profile of ICRF heating is analyzed using a ray-tracing code, and used to explain the observed B_T dependence. This paper also deals with a class of strange shots observed in the same series of experiments. They appeared at a power level close to the H-mode threshold with a remarkable improvement of confinement. However, they are different from the H-mode in the time evolution of the profiles. (author).

53945 (IPPJ–910) **Stochasticity and symmetry of the standard map.** Ichikawa, Y.H.; Kamimura, T.; Hatori, T.; Kim, S.Y. Nagoya Univ. (Japan). Inst. of Plasma Physics. Apr 1989. 37p. Order Number DE90709987. Available from NTIS (US Sales Only), PC A03/MF A01.

The stochasticity and symmetry of the standard map have been discussed to explore the generic aspect of the statistical properties inherent to the low dimensional classical Hamiltonian systems. The accelerator modes of the standard map give rise to anomalous enhancement of the stochastic diffusion. Systematic analysis of symmetry of the standard map is undertaken to investigate structure of the periodic orbits around the stable fixed point, and the method is applied to the Poincare-Birkhoff chains around the accelerator mode. The squeeze effect of the period-3 accelerator orbits is examined explicitly, in terms of the reduced accelerator mode map. Furthermore, it is shown that the period-3 accerator orbits are born as intrinsic nonlinear multifurcation, differing from birth of the Poincare-Birhoff chains with the higher periodicity $q \geq 4$. (author).

53946 (IPPJ–911) **Chaotic magnetic field line in toroidal plasmas.** Hatori, Tadatsugu; Abe, Yoshihiko; Urata, Kazuhiro; Irie, Haruyuki. Nagoya Univ. (Japan). Inst. of Plasma Physics. May 1989. 63p. Order Number DE90710052. Available from NTIS (US Sales Only), PC A04/MF A01.

This is an introductory review of chaotic magnetic field line in plasmas, together with some new results, with emphasis on the long-time tail and the fractional Brownian motion of the magnetic field line. The chaotic magnetic field line in toroidal plasmas is a typical chaotic phenomena in the Hamiltonian dynamical systems. The onset of stochasticity induced by a major magnetic perturbation is thought to cause a macroscopic rapid phenomena called the current disruption in the tokamak discharges. Numerical simulations on the basis of magnetohydrodynamics reveal in fact the disruptive phenomena. Some dynamical models which include the area-preserving mapping such as the standard mapping, and the two-wave Hamiltonian system can model the stochastic magnetic field. Theoretical results with use of the functional integral representation are given regarding the long-time tail on the basis of the radial twist mapping. It is shown that application of renormalization group technique to chaotic orbit in the two-wave Hamiltonian system proves decay of the velocity autocorrelation function with the power law. Some new numerical results are presented which supports these theoretical results. (author).

53947 (IPPJ–912) **Full consistent analysis of high beta steady state tokamaks sustained by beam driven and bootstrap currents.** Okano, K.; Ogawa, Y.; Naitou, H. Nagoya Univ. (Japan). Inst. of Plasma Physics. May 1989. 45p. Order Number DE90710053. Available from NTIS (US Sales Only), PC A03/MF A01.

Beam driven steady state tokamaks of moderate size (R_0 = 4.55 m) is analyzed by a full consistent beam current drive analysis code, which consistently includes MHD equilibrium, kink and ballooning stability analysis, bootstrap current, power balance and momentum balance calculations. It was found that this moderate size is sufficient to demonstrate the feasibility of steady state operation by the neutral beam current drive. The maximum Q value attains Q = 7~9 with the fusion power P_f = 500~800 MW and L-mode confinement is sufficient to sustain self consistent equilibria. The Q value is nearly doubled due to the bootstrap current and the $T_i > T_e$ feature of beam driven tokamaks. The optimum beam energy is 1.0~1.2 MeV and the toroidal rotation effects has been negligible. (author).

53948 (IPPJ–913) **Improved confinement in high density ohmic discharge in JIPP T-IIU.** Hamada, Y.; Sakamoto, M.; Sato, K.N. and others. Nagoya Univ. (Japan). Inst. of Plasma Physics. May 1989. 12p. Order Number DE90710054. Available from NTIS (US Sales Only), PC A03/MF A01.

The improvement of the confinement of the ohmic plasma with limiter configuration, similar to the improved ohmic confinement (IOC) mode of ASDEX, is observed in JIPP T-IIU. The features of our IOC mode are summarized in the following way. (1) the circular limiter-plasma instead of the divertor plasma, (2) very high density threshold for IOC in contrast to the ASDEX IOC mode. (3) no enhanced radiation due to impurity accumulation. The preliminary experimental results are discussed. (author).

53949 (IPPJ–914). **Effect of a converter electrode in a multicusp negative ion source.** Ramos, H.J.; Sasao, Mamiko; Yamaoka, Hitoshi; Wada, Motoi. Nagoya Univ. (Japan). Inst. of Plasma Physics. May 1989. 17p. Order Number DE90710055. Available from NTIS (US Sales Only), PC A03/MF A01.

The electron temperature of a negative ion source has to be low so as not to destroy produced negative ions by electron impact processes. The bulk plasma characteristics of a multicusp negative ion source with a converter electrode are examined by a probe data acquisition system for two cases; converter with cesium and converter without cesium. The effects of the converter bias on bulk plasma parameters have been observed when cesium is not introduced. Under cesiated discharge condition, the converter bias effects are obscure. The addition of cesium into a helium discharge decreases the high energy electron component, which is unfavorable from a view point of negative ion extraction, and hence lowers the electron temperature. (author).

53950 (IPPJ–915) **New method of testing nuclear fusion in metals.** Itoh, Noriaki. Nagoya Univ. (Japan). Inst. of Plasma Physics. May 1989. 5p. Order Number DE90710056. Available from NTIS (US Sales Only), PC A02/MF A01.

A new crucial test for nuclear fusion in palladium or titanium metal is suggested. This method is capable to heat a deuterium-metal mixture to a given temperature, and hence is expected to yield detailed information on fusion reactions in metallic environments. (author).

53951 (IPPJ-DT–148) **Orbit calculation for heavy ion beam probe system on JIPPT-IIU.** Fujita, Hideki; Hamada, Yasuzi. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. 17p. (In Japanese). Order Number DE90709993. Available from NTIS (US Sales Only), PC A03/MF A01.

This is a report of orbit calculation for heavy ion beam probe system which is designed to measure radial and poloidal wave numbers of density and potential fluctuations in the JIPPT-IIU plasma. Multi-channel detectors are adopted in energy analyzer to measure fluctuations at multiple points in the plasma simultaneously. (author).

53952 (IPPJ-T–39) **New method for measuring phase shift in heterodyne interferometric measurement.** Bi, D.G.; Kubo, S.; Nishizawa, A.; Takahashi, C.; Fujita, J. Nagoya Univ. (Japan). Inst. of Plasma Physics. May 1989. 31p. Order Number DE90710051. Available from NTIS (US Sales Only), PC A03/MF A01.

A new method for analysing the phase shift of heterodyne interferometric beat is developed. The phase shift is obtained directly from the change in the probe beat period without comparing with reference beat. According to this method an electric circuit system has been designed, combined with an HCN laser or microwave interferometer for the measurement of line-integrated electron density of plasma in Compact Helical System (CHS). The experimental results show that this method is effective. The minimum measurable phase shift is determined by the ratio of beat frequency to the counting clock frequency, and the maximum measurable phase shift is infinite in principle. (author).

53953 (JAERI-M–89-056) **Operational limits and disruptions in tokamaks. Status and application to ITER.** Tsunematsu, Toshihide; Hogan, J.; Borrass, K.; Engelmann, F. Japan Atomic Energy Research Inst., Tokyo (Japan). May 1989. 51p. Order Number DE90710037. Available from NTIS (US Sales Only), PC A04/MF A01.

This report contains a concise description on status of knowledge in the area of operational limits and disruption characteristics, based on the results of workshops held during the ITER Definition Phase (1988). (author).

53954 (NIIEFA-P-NILSA–07-89) **Optimization of compact tokamak for thermonuclear burning investigation.** Katyshev, V.V.; Krivosheev, M.V. Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR). 1988. 13p. (In Russian). Order Number DE90603249. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

T-11647.

Results of optimization investigations of a tokamak with ignition obtained using the device simplified mathematical model are presented. The model includes plasma parameter computation unit and units describing main tokamak elements: electromagnetic system consisting of precooled toroidal and poloidal field windings (TFW and PFW), plasma heating and power supply systems. Minimization of tokamak cost (taking account of physical and technical limitations) was numerically calculated with respect to 12 independent variables using method of slipping allowance. The developed mathematical model can be used in preparing RFP (request for proposal) on design of experimental thermonuclear reactor. 10 refs.; 2 figs.; 1 tab.

53955 (ORNL–6551/V2) **Atomic Data for Fusion: Volume 6, Spectroscopic data for titanium, chromium, and nickel: Volume 2: Chromium.** Wiese, W.L.; Musgrove, A. (eds.). Oak Ridge National Lab., TN (USA). Sep 1989. 279p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90000969. Available from NTIS, PC A13/MF A01; OSTI; INIS; GPO Dep.

Comprehensive spectroscopic data tables are presented for all ionization stages of chromium. Tables of ionization potentials, spectral lines, energy levels, and transition probabilities are presented. These tables contain data which have been excerpted from general critical compilations prepared under the sponsorship of the National Standard Reference Data System (NSRDS).

53956 (ORNL/FTR–2480) **[MHD activity in JET]: Foreign trip report, December 6–20, 1986.** Holmes, J.A. Oak Ridge National Lab., TN (USA). 9 Jan 1987. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89017410. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The first two above-stated purposes for this trip, namely those covered in the visit to the Soviet Union, are discussed in the group trip report of the entire delegation. The following contribution concerns the visit of the traveler to Culham Laboratory and JET for the purpose of understanding MHD activity in JET and other large tokamaks.

53957 (ORNL/FTR–2602) **[MHD calculations in tokamaks]: Foreign trip report, May 16–June 27, 1987.** Charlton, L.A. Oak Ridge National Lab., TN (USA). 13 Jul 1987. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89017347. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Reaction to colloquia given in Lausanne and Culham is described. Information exchanged is detailed and work done at Culham is described. Perhaps the most interesting exchanges dealt with: (1) the fast sawtooth drop phenomena seen on advanced tokamak devices and (2) the physics of small-aspect-ratio tokamaks. Collaborative research was started at Culham to study infernal modes that may provide a beta limit in some devices.

53958 (ORNL/FTR–3386) **[Review of the status of atomic and molecular data for fusion edge plasma studies]: Foreign trip report, September 9, 1989–September 16, 1989.** Phaneuf, R.A. Oak Ridge National Lab., TN (USA). 2 Oct 1989. 18p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90001244. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Representatives from both magnetic fusion plasma and atomic/molecular physics research reviewed the data requirements and the status of the atomic and molecular data base for fusion edge plasma studies. A number of significant gaps in the required data base were identified, particularly for processes involving hydrocarbon molecules. Comprehensive reviews on various sub-topics will be prepared and coordinated by the IAEA for publication in a special 1990 supplement to Nuclear Fusion. The Data Center Network assessed worldwide data compilation/evaluation activities for magnetic fusion, and the implementation of the ALADDIN data base and exchange system. This system has been widely adopted and favorably received as an effective solution to the creation, distribution, and implementation of data bases in magnetic fusion research. With input from the various data centers, the IAEA will assemble complete ALADDIN data bases and interfaces for two widely used tokamak neutral and impurity transport codes. The objective is to provide the best available atomic and molecular data for fusion applications. Under the strong leadership of R.K. Janev, the Atomic and Molecular Data Unit of the IAEA has assumed a very aggressive role in the compilation of a recommended numerical data base and in promoting its application in fusion research.

53959 (ORNL/TM–11177) **Bibliography of fusion product physics in tokamaks.** Hively, L.M.; Sigmar, D.J. Oak Ridge National Lab., TN (USA). Sep 1989. 61p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90000981. Available from NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.

Almost 700 citations have been compiled as the first step in reviewing the recent research on tokamak fusion product effects in tokamaks. The publications are listed alphabetically by the last name of the first author and by subject category.

53960 (PB–89-867550/XAB) **Nuclear fusion. January 1978-January 1982 (Citations from the NTIS data base). Report for January 1978-January 1982.** National Technical Information Service, Springfield, VA (USA). Aug 1989. 105p. Available from NTISPC N01/MF N01.

See also PB–89-867568.

This bibliography contains citations concerning initiation of thermonuclear reactions by the control of high-temperature plasmas. Studies are included on MHD and various magnetic fusion devices. Studies sponsored solely by the Department of Energy (DOE) are excluded. (This updated bibliography contains 212 citations, none of which are new entries to the previous edition.)

53961 (PB–89-867568/XAB) **Nuclear fusion. February 1982-July 1989 (Citations from the NTIS database). Report for February 1982-July 1989.** National Technical Information Service, Springfield, VA (USA). Aug 1989. 211p. Available from NTISPC N01/MF N01.

Supersedes PB–82-804956. See also PB–89-867550.

This bibliography contains citations concerning initiation of thermonuclear reactions by the control of high-temperature plasmas. Studies are included on MHD and various magnetic fusion devices. Studies sponsored solely by the Department of Energy (DOE) are excluded. (This updated bibliography contains 428 citations, all of which are new entries to the previous edition.)

53962 (UCLA/PPG–1263) **Abstracts submitted for the thirty-first annual meeting, Division of Plasma Physics, November 13–17, 1989.** California Univ., Los Angeles, CA (USA). Inst. of Plasma and Fusion Research. Sep 1989. 41p. Sponsored by U.S. DOE Energy Research. DOE Contract FG03-86ER52134;FG03-86ER52126;FG03-86ER52130;FG03- (CONF-891106–Absts.: 31. annual meeting of the Division of Plasma Physics of the American Physical Society, Anaheim, CA (USA), 13-17 Nov 1989). Order Number DE90000948. Available from NTIS, PC A04/MF A01; OSTI; INIS.

This report contains abstracts of papers that are submitted for the 31st annual meeting of the Division of Plasma Physics, November 13–17, 1989. (LSP)

53963 X-ray plasma spectroscopy and the properties of multiply-charged ions. Proceedings of the Lebedev Physics Institute, Academy of Sciences of the USSR. Volume 179. Sobel'man, I.I. 256p. Nova Science Publishers, Inc., Commack, NY (1988).

This book provides the proceedings of the Lebedev Physics Institute Academy of Sciences of the U.S.S.R. Included are papers on laser plasma, spectroscopy, and the properties of multiply-charged ions.

53964 Experimental investigation of driven Alfven-wave resonances on the PRETEXT tokamak. Booth, W.D. Thesis (Ph. D.). 113p. Univ. of Texas, Austin, TX (US) (1988). Available from University Microfilms, PO Box 1764, Ann Arbor, MI 48106, Order No.88-16,401.

The results of the recent Alfven-wave experiments conducted on the PRETEXT tokamak are presented. Two quarter-turn toroidal antennas were used to drive 2.1-MHz Alfven waves in the PRETEXT plasma. Three different Global Alfven Eigenmodes were identified. The resonance frequency for each of the three observed modes was compared to the value predicted by calculation. The value of the antenna loading associated with each global resonance was measured and also compared to values predicted by a kinetic model. Additionally, the radial profile of the RF magnetic field was measured to a depth of five centimeters past the limiter in the plasma, and these magnetic fields were compared to predicted values. Generally good agreement was found between measured and predicted values. The resonance frequencies of the global modes agreed quite well and the value of the antenna loading agreed to within about 20%. The width of the measured resonances was much wider than the width of the calculated resonances. This difference is attributed principally to losses in the antenna impedance-matching system.

53965 Microstability of the sloshing ions in TMX-U. Berzins, L.V. Thesis (Ph. D.). 175p. Univ. of California, Davis, CA (US) (1988). Available from University Microfilms, PO Box 1764, Ann Arbor, MI 48106, Order No.88-14,289.

The microstability of the sloshing ions in the Tandem Mirror Experiment-Upgrade (TMX-U) was measured. This is the first experimental measurement of the microstability of a sloshing-ion distribution. It was found that the sloshing ions were unstable to the drift-cyclotron loss-cone instability. This instability was driven at the outer turning point of the sloshing ions. Experimental observations are compared with theoretical predictions for the drift-cyclotron loss-cone instability. It was on the basis of these comparisons that this instability was identified as the drift-cyclotron loss-cone instability. This instability affected the lifetime of the sloshing ions. The author compared the observed scaling of the sloshing-ion lifetime with the amplitude of the instability to the results of a quasi-linear theory where ion trapping is important. He shows that this instability can be stabilized by two different cold-ion populations in TMX-U. He observed warm-plasma stabilization of the instability by the cold-ion end losses. The amount of stream necessary to stabilize the instability is consistent with the theory for the drift cyclotron loss-cone instability. He also shows that warm ions trapped at the midplane can stabilize this instability, even though the instability is driven at a location removed from the midplane. This is the first experimental verification of the stabilizing effect of trapped ions for a sloshing-ion distribution.

53966 Electron behavior during electron cyclotron resonance heating in the interchangeable-module stellarator. Trost, P.K. Thesis (Ph. D.). 171p. Univ. of Wisconsin, Madison, WI (US) (1988). Available from University Microfilms, PO Box 1764, Ann Arbor, MI 48106, Order No.88-10,046.

Experimental and theoretical studies of the electron distribution function during electron-cyclotron-resonant heating of a target plasma in the Interchangeable Module Stellarator (IMS) were performed. Experimental results show an electron energy distribution with a bulk Maxwellian component (f_0) with a temperature of 10-25 eV, and a warm component (f_1) with an average energy of 140-160 eV. The Maxwellian part of the distribution is measured by Thomson scattering and a swept Langmuir probe. The warm component is determined by the additional transition curve that such a distribution contributes to the swept Langmuir probe I-V characteristic. The electron energy distribution is derived theoretically with the use of a particle-following Monte Carlo simulation. To model the ECH interactions with the electrons, an rf collision model, is based on stochastic electron-wave interactions, is used. Results from this code are cast into a form that allows direct comparison with experimental results. The experimentally obtained results and the calculated distributions agree well within the experimental error for densities and temperatures of the warm component over several resonant surface-interaction topologies.

53967 Experimental investigation of the dynamics of pellet ablation on the Texas Experimental Tokamak. Durst, R.D. Thesis (Ph. D.). 147p. Univ. of Texas, Austin, TX (US) (1988). Available from University Microfilms, PO Box 1764, Ann Arbor, MI 48106, Order No.88-16,448.

Rapid fluctuations in the ablation of hydrogen pellets in the Texas Experimental Tokamak were studied using fast photographic techniques. It is proposed that the fluctuations are a type of relaxation oscillation driven by the motion of the particle across the magnetic field. This is shown to be consistent with a time-dependent model of plasma shielding due to Kaufmann et al. A technique to include this effect in calculations of pellet ablation is discussed. Spatially resolved measurements of the temperature and density in the pellet-ablation cloud were obtained by line-to-continuum ratios and Stark broadening, respectively. Typical parameters in the pellet-ablation cloud are 5-6 eV and 1.0-1.5 x 10^{17} cm^{-3}. The flow along

the magnetic field is found to be isobaric. The heating of the expanding ablatant is strongly asymmetric, being stronger on the side facing the electron-drift direction. This may be due to suprathermal electrons.

53968 Time-of-flight potential diagnostics for tandem mirrors. Archer, B.T. III. Thesis (Ph. D.). 154p. Univ. of California, Berkeley, CA (US) (1987). Available from University Microfilms, PO Box 1764, Ann Arbor, MI 48106, Order No.88-13,779.

Two time-of-flight potential diagnostics for tandem mirrors are investigated. These diagnostics are designed to measure axial potential variations in tandem-mirror plasma geometries. One approach investigated employs an electron beam as a potential probe, and the other employs a helium ion beam. In each case, a modulated beam is injected along the magnetic axis of the magnetic field into the plasma confinement region. The velocity of the beam particles varies as the beam moves through variations in the electrostatic potential. Since the beam is modulated, variations in beam velocity modify the modulation phase of the beam along the beam trajectory. In the case of the electron beam, the phase of the beam is remotely detected by using a Rogowski loop that encircles the plasma. The phase of the helium ion beam can be measured by observing the light emitted by the helium ions. A theoretical study was made regarding the feasibility of the modulated ion beam concept for measuring potentials in the TMX-U and MFTF-B tandem mirrors machines at the Lawrence Livermore National Laboratory. The estimated potential uncertainties for these machines appear quite small, provided an ion beam of the required quality can be modulated at a high enough frequency. In order to address this concern, a 5-k-V, 10-mA ion beam was designed, fabricated, and tested.

53969 Tokamak fusion-reactor design using recent theoretical models of heat transport. Ibrahim, E. Thesis (Ph. D.). 115p. Univ. of California, Berkeley, CA (US) (1987). Available from University Microfilms, PO Box 1764, Ann Arbor, MI 48106, Order No.88-13,922.

A survey of several theoretical models of heat transport is presented, culminating in the development of a one-fluid and a two-fluid transport model. The one-fluid model is based on the assumption that the ion and electron thermal diffusivity is equal to the thermal diffusivity due to η_i modes. The two fluid model is based on the assumption that the electron thermal transport is due to trapped-electron mode instability and the ion thermal transport is due to neoclassical diffusion, in the banana regime, and additionally due to η_i modes when $\eta_i < \eta_{ic} = 1.5$. The two-fluid model predicts a τ_E scaling that is in reasonable agreement with the empirical τ_E scaling for auxiliary heated tokamaks known as Kaye-Goldston Scaling. The two-fluid model's τ_E scaling is used to design the smallest-size tokamak fusion reactor that can achieve ignition. The design parameters of this reactor are given.

53970 Effect of wave localization on plasma instabilities. Levedahl, W.K. Thesis (Ph. D.). 131p. Univ. of California, Berkeley, CA (US) (1987). Available from University Microfilms, PO Box 1764, Ann Arbor, MI 48106, Order No.88-13,958.

The Anderson model of wave localization in random media is invoked to study the effect of solar-wind density turbulence on plasma processes associated with the solar type-III radio burst. ISEE-3 satellite data indicate that a possible model for the type-III process is the parametric decay of Langmuir waves excited by solar-flare electron streams into daughter electromagnetic and ion-acoustic waves. The threshold for this instability, however, is much higher than observed Langmuir-wave levels because of rapid wave convection of the transverse electromagnetic daughter wave in the case where the solar wind is assumed homogeneous. Langmuir and transverse waves near critical density satisfy the Ioffe-Riegel criteria for wave localization in the solar wind with observed density fluctuations ~1%. Computer simulations using a linearized hybrid code show that an electron beam will excite localized Langmuir waves in a plasma with density turbulence. An action-principle approach is used to develop a theory of nonlinear wave processes when waves are localized. A theory of resonant particles diffusion by localized waves is developed to explain the saturation of the beam-plasma instability.

53971 Computer simulation of bounded plasmas. Lawson, W.S. Thesis (Ph. D.). 165p. Univ. of California, Berkeley, CA (US) (1987). Available from University Microfilms, PO Box 1764, Ann Arbor, MI 48106, Order No.88-13,952.

The problems of simulating a one-dimensional bounded plasma system using particles in a gridded space are systematically explored and solutions to them are given. Such problems include the injection of particles at the boundaries, the solution of Poisson's equation, and the inclusion of an external circuit between the confining boundaries. A recently discovered artificial cooling effect is explained as being a side-effect of quiet injection, and its potential for causing serious but subtle errors in bounded simulation is noted. The methods described in the first part of the thesis are then applied to the simulation of an extension of the Pierce diode problem, specifically a Pierce diode modified by an external circuit between the electrodes. The results of these simulations agree to high accuracy with theory when a theory exists, and also show some interesting chaotic behavior in certain parameter regimes. The chaotic behavior is described in detail.

53972 Parametric study of axisymmetric fusion devices. Ducar, W.S. Thesis (Ph. D.). 186p. Univ. of California, Davis, CA (US) (1987). Available from University Microfilms, PO Box 1764, Ann Arbor, MI 48106, Order No.88-09,749.

Three different axisymmetric magnetic mirror fusion machines are examined in order to optimize the ratio the fusion power produced by them to the power injected into them to maintain the plasma. These three devices were chosen to study the continuum between a simple mirror and a tandem mirror. This allowed the evolutionary process leading from the simple to the tandem mirror to be examined in detail. The Kelley mirror, which corresponds to the middle step, was examined in depth for the first time. A computer code that models the plasma in these machines was written to investigate the steady-state operation of these machines. The balance equations are solved by using an ordinary differential equation solver, LSODE, to numerically solve the system of differential equations. The computer model was used to examine parameter space to optimize Q for each of the three machines. When feasible, a comparison with a Fokker-Planck code was made for the optimal Q case for each machine. Finally, the possible roles these devices might fill was discussed.

53973 Some aspects of plasma kinetic theory: Energetic particle physics; renormalization theory; anomalous electron transport in tokamaks. Zhang, Yangzhong. Thesis (Ph. D.). 262p. Univ. of Texas, Austin, TX (1988). Available from University Microfilms, PO Box 1764, Ann Arbor, MI 48106, Order No.88-16,625.

This dissertation discusses three special topics of collisionless plasma kinetic theory and their applications pertinent to high-temperature magnetic-confinement experiments oriented to nuclear fusion research. The first topic is energetic-particle physics. Appropriate equations are derived from first principles and applied to mirror configurations. A significant contribution is the prediction of a diamagnetic limit due to negative-energy precessional waves. Discussion is given on whether experiments exist that violate this stability limit. The major theme of the second topic is construction of rigorous formal systematology for nonlinear Vlasov equations with electromagnetic interactions in order to produce a renormalized perturbation theory to arbitrary higher order. The last topic is the theoretical study of anomalous electron energy transport in a tokamak. In combination with phenomenological analysis, a formula for local electron energy transport coefficient is proposed on the theoretical basis for strong microturbulence on the scale of the electromagnetic skin depth.

53974 Patches of electrons and electron sheets for the 1-D Vlasov-Poisson equation. Dziurzynski, R.S. Thesis (Ph. D.). 215p. Univ. of California, Berkeley, CA (US) (1987). Available from University Microfilms, PO Box 1764, Ann Arbor, MI 48106, Order No.88-13,858.

The author studies two classes of weak solutions for the 1-D Vlasov-Poisson equation describing plasma flows - patches of electrons and electron sheets. These solutions are analogous to patches of vorticity and vortex sheets for the 2-D vorticity equation. First, the existence of a given electron density is proved. It is shown that the corresponding flow map is Lipschitz continuous globally in

time - so any initially smooth curve evolving with the flow remains rectifiable. Then the contour dynamics equation is derived for evolution of the boundaries z (α, t) of electron layers. The existence and uniqueness of smooth z(α, t) is proved up to the time t_* of folding formation. The author designs a numerical method, proves its second-order convergence, and computes several numerical solutions. Finally, he derives equations for evolution of regularized and limit electron sheets. He designs numerical methods, proves their second-order convergence, and computes several numerical solutions. He derives a large class of exact solutions z (α, t).

53975 Magnetic- and material-limiter discharges in Tokapole II. Moyer, R.A. Thesis (Ph. D.). 340p. Univ. of Wisconsin, Madison, WI (US) (1988). Available from University Microfilms, PO Box 1764, Ann Arbor, MI 48106, Order No.88-10,477.

Disruptive instabilities were studied in Tokapole II, a small poloidal-divertor tokamak, in magnetic- and material-limiter configurations. In the magnetic limiter configuration, the divertor separatrix defines the tokamak current channel boundary. Limiters or neutralizer plate are not used to remove plasma in the scrape-off region. The relatively hot, dense plasma in the scrape-off region carries 5-20% of the current. In the material-limiter configuration, limiter plates are inserted to the separatrix to remove plasma and current in the scrape-off region. The plates vary the tokamak current-channel boundary condition in a controlled manner, and provide a benchmark for comparison with other tokamaks. Internal and external disruptions have been studied, and several unique features in the magnetic-limiter configuration were identified. The magnetic-limiter configuration enables routine passing of the stability barriers at q(a) = 2 and q(a) = 1, where q(a) is the edge safety factor, without a close-fitting wall, external windings, or detailed profile control techniques. Passing the q(a) = 1 barrier permits operation in the $q < 1$ regime where total reconnection of the sawtooth does not occur.

53976 Self-consistent bounce-averaged transport computations for stellarators. D'haeseleer, W.D. Thesis (Ph. D.). 463p. Univ. of Wisconsin, Madison, WI (US) (1988). Available from University Microfilms, PO Box 1764, Ann Arbor, MI 48106, Order No.88-10,012.

A numerical code FLOCS (Flow Code for Stellarators), which computes the self-consistent radial particle fluxes and the bootstrap current in stellarators, was developed. The code finds the distribution function $\bar{f}$, as a function of three variables, one spatial, Θ, and two in velocity space, E and y where y is the ripple-depth parameter. $\bar{f}$ is computed on a fixed-flux surface, and bounce averaging over the helical ripples effectively eliminates the toroidal angle from the problem. The energy-integrated particle fluxes are computed, and the balance point where ion and electron fluxes are equal determines the ambipolar electric field. To perform the integrations over pitch angle to find the parallel flows, a multi-mesh method in y is employed. The impact of momentum-restoring terms in the collision operator, C is evaluated. Theoretically, their presence is required to replace the parallel momentum that is lost by the Lorentz part of C. Results are presented for a stellarator-reactor plasma extrapolated from ATF parameters.

53977 Review of impact fusion concepts. Ribe, F.L. (Washington Univ., Seattle, WA (USA). Dept. of Nuclear Engineering); Barnes, D.C. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics (USA),* 25(1): 20-26 (Jan 1989).

The authors review the main features of the impact fusion concept in which gram-sized metallic projectiles from electromagnetic launchers collide around heavy-hydrogen fusile gas to produce thermonuclear plasma whose pressure brings the projectiles to rest, providing a pulse of fusion power during the "turnaround" of the projectiles. A quasispherical implosion of the projectile metal about the gas cavity is necessary to achieve sufficient fusion energy gain. Hydrodynamic calculations show that initial projectile rectilinear motion can be converted to such an implosion. The required projectile velocity can be greatly reduced by means of magnetic insulation of the plasma. Here closed-line magnetic fields reduce the thermal conduction to the metallic cavity wall, allowing a longer heat-diffusion time to replace the inertial stagnation time of the projectiles against the fusion plasma. The linked poloidal and toroidal fields of the final magnetic configuration constitute magnetic helicity H which is approximately conserved during the entire impact. This allows magnetic fields in the initial "struck" configuration with convenient open magnetic geometry to be suitably linked during the plasma compression to produce the final closed magnetic configuration. Even when the initial open fields have no helicity, such helicity can be produced during the impact by mechanical injection of helicity from the moving contact circle of the projectiles at their interface.

53978 Periodic traveling waves bifurcating from multi-humped vlasov equilibria. Holloway, J.P.; Dorning, J.J. *Transactions of the American Nuclear Society (USA),* 56: 311-313 (1988). (CONF-880601--: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

This analysis provides solutions to the full nonlinear plasma oscillation problem near Vlasov equilibria, the linearized version of which was first studied by Vlasov, Landau, Van Kampen, and Case.

53979 Characteristic finite element method for the vlasov-poisson system. Victory, H.D. Jr.; Ganguly, K. *Transactions of the American Nuclear Society (USA),* 56: 313-314 (1988). (CONF-880601--: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

In particle simulation of plasmas, the initial positions and velocities of the particles are chosen according to the initial distribution function either randomly or in an ordered manner. The authors present the algorithm for the multidimensional Vlasov-Poisson system. The electrostatic energy calculated by the present method compares well with the particle simulation results up to a time of 10 plasma periods. Beyond this, the algorithm does not perform well due to the fine structure of f(t,x,v) as time increases. A suitable refinement of the present algorithm awaits further work.

53980 Response times and energy partitioning in electron-beam-excited plasmas. Kushner, M.J. (University of Illinois, Department of Electrical and Computer Engineering, Gaseous Electronics Laboratory, 607 East Healey, Champaign, Illinois 61820 (US)). *Journal of Applied Physics (USA),* 66(6): 2297-2306 (15 Sep 1989).

Excimer lasers are typically excited by electron beams (*e* beams) with initial energies of 100's of keV to a few MeV. The *e*-beam response time is the interval required for beam electrons and their energetic secondary electrons to slow below the first inelastic thresholds of the buffer gas, below which the electrons thermalize by elastic momentum transfer collisions. In this paper, *e*-beam response times for rare gases and for gas mixtures typically used for excimer lasers are discussed using results from a Monte Carlo simulation. Issues pertaining to energy partitioning (*W* values in mixtures and effective electron temperatures) are also discussed. We find that *e*-beam response times may be >10's of ns in gas mixtures of a few atm. As these times are commensurate with the rise time of *e*-beam pulses or the width of shorter pulses, beam slowing effects must be considered when modeling these phases of *e*-beam pumping.

53981 Current channel migration and magnetic field penetration in a perfectly conducting plasma with emitting, conducting boundaries. Grossmann, J.M. (Plasma Physics Division, Naval Research Laboratory, Washington, DC 20375-5000 (US)); Ottinger, P.F.; Mason, R.J. *Journal of Applied Physics (USA),* 66(6): 2307-2314 (15 Sep 1989).

In collisionless simulations of the plasma erosion opening switch, a highly conductive plasma allows magnetic field penetration through the entire length of the plasma, to depths almost two orders of magnitude greater than the collisionless skin depth, c/ω_{pe}. Field penetration is accomplished by a narrow (skin-depth-like) current channel that migrates through the plasma. The plasma behind the current channel is unable to shield the rising magnetic field from the body of the plasma and allows it to penetrate almost instantly and completely through the plasma up to the current channel. The migration of the channel and the penetration of the field appear to occur in the absence of both Coulomb collisions and instabilities. These unusual features are permitted by the electric field structure in the plasma behind the current channel and the presence of conducting boundaries that can emit electrons.

53982 An elliptical spectrograph/fiber-array/streak camera system for remote time-resolved spectral measurements in the

x-ray region. Hammel, B.A. (Sandia National Laboratories, Albuquerque, New Mexico (US)); Ruggles, L.E. *Review of Scientific Instruments (USA),* 60(9): 2861-2867 (Sep 1989). DOE Contract AC04-76DP00789.

An elliptical spectrograph and a scintillator/fiber-array detection system have been developed to provide time-resolved measurements of the x-ray spectra from a *Z*-pinch plasma. The elliptical spectrograph (1.2-m focal distance, eccentricity=0.9586) observes the 1-keV region, covering a range of $\lambda/2d$=0.5–0.9. The detector consists of a thin scintillator butt-coupled to a fiber optic array which transmits the signal to a streak camera in a remote location. This system provides continuous time history with temporal resolution of ~3 ns, and a spectral resolving power of ~165. The detection scheme is limited to spectral lines with intensities greater than $\sim 10^6$ W/sr-eV.

53983 A method to measure magnetic field perturbations in plasma devices. Jackson, G.L. (General Atomics, P.O. Box 85608, San Diego, California 92138 (US)); DeGrassie, J.S.; Schaffer, M.J.; Taylor, T.S.; Gentle, K.W. *Review of Scientific Instruments (USA),* 60(9): 2883-2887 (Sep 1989).

Magnetic field perturbations with specific spatial geometry can be detected in the presence of a large magnetic field "background" using printed circuit pickup coils which have the advantages of large effective area, near dc frequency response, precise geometry, thin profile, and low cost. The design and construction techniques to produce these coils are presented. A printed circuit coil has been used to detect the magnetic field from the perturbed plasma current distribution in the TEXT tokamak due to current in an external helical (m=7,n=3) winding. The measured sensitivity of this coil, $\Delta B_{coil}/B_{total}$, is $\sim 3 \times 10^{-6}$.

53984 Two-dimensional plasma-electron temperature measurements. Goodman, D.L. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139 (US)). *Review of Scientific Instruments (USA),* 60(9): 2835-2837 (Sep 1989).

A system to measure the two-dimensional cold-electron temperature profile in a magnetic confinement laboratory plasma is described. Using a digital storage CCD camera, image intensifier, and optical transmission filters, a two-dimensional helium-line emission-ratio measurement shows plasma features which are not possible to resolve using only a single detector or an array of detectors. The system is especially useful for nonaxisymmetric magnetic geometries, where the three-dimensional equilibria make interpretation of more standard measurements difficult. Other two-dimensional plasma-profile measurements including density and ionization source measurements are also possible using the system.

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Refer also to citation(s) 52613, 52901, 52916, 52917, 52982, 53930, 53969, 53977, 54045

53985 (ANL/FPP/TM–240) **KAOS-V code: An evaluation tool for neutron kerma factors and other nuclear responses.** Farawila, Y.; Gohar, Y.; Maynard, C. Argonne National Lab., IL (USA). Sep 1989. 122p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. Order Number DE90000989. Available from NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.

The accurate evaluation of neutron fluence-to-kerma factors from microscopic nuclear data is the subject of this report. The algorithms developed for this purpose combine in a consistent manner the two basic methods for computing kerma factors, namely kinematics and direct energy balance. These algorithms are implemented in the code KAOS-V which was used as the main evaluation tool to construct the response function library KAOS/LIB-V. KAOS-V uses data from the evaluated nuclear data files ENDF/B/V. Auxiliary nuclear data bases, e.g., the Japanese evaluated nuclear data library JENDL-2 can be used as a source of isotopic cross sections when these data are not provided in ENDF/B-V files for a natural element. These are needed mainly to estimate average quantities such as effective Q-values for the natural element. The code has the ability to compare the different results which aids in the choice of a consistent set of algorithms to evaluate kerma factors. Data in ENDF/B-IV and ENDF/B-V format can be processed. For resonance treatment, the code has the ability to access NJOY and NPTXS interface files in formatted or binary forms. No input instructions are necessary to run the code interactively. The user can simply respond to the interactive messages sent by the code if an INPUT file is absent. An INPUT file is automatically generated following an interactive run, and can be edited and used to rerun or produce different results. Grouped and point output data can be produced along with graphic representation. These features are instrumental in detecting and understanding energy balance deficiencies and other problems in the nuclear data files. 60 refs., 4 figs.

53986 (CNIC–00209) **Fusion-fission fuel factory conceptual design for China.** Qiu Lijian. China Nuclear Information Centre, Beijing, BJ (China). Apr 1988. 15p. (In Chinese). Order Number DE90603380. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The necessity and technical feasibility of a Fusion-Fission Fuel Factory for supporting PWR nuclear power station in China has been investigated both through parametic system studies and some key fusion nuclear technology experiments. The main aim is to study the reality for fuelling an experimental fusion-fission hybrid reactor at the beginning of the next centry in Chian. The study demonstrates that the fusion-fission hybrid reactor has the potential to cover a wider range of reasonable sizes and existing technology than that has been considered perviously.

53987 (CONF-891007–17) **Characteristics of an electron-beam rocket pellet accelerator.** Tsai, C.C.; Foster, C.A.; Schechter, D.E. Oak Ridge National Lab., TN (USA). [1989]. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 13. international symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. Order Number DE90001595. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

An electron-beam rocket pellet accelerator has been designed, built, assembled, and tested as a proof-of-principle (POP) apparatus. The main goal of accelerators based on this concept is to use intense electron-beam heating and ablation of a hydrogen propellant stick to accelerate deuterium and/or tritium pellets to ultrahigh speeds (10 to 20 km/s) for plasma fueling of next-generation fusion devices such as the International Thermonuclear Engineering Reactor (ITER). The POP apparatus is described and initial results of pellet acceleration experiments are presented. Conceptual ultrahigh-speed pellet accelerators are discussed. 14 refs., 8 figs.

53988 (CONF-891007–19) **Tritium proof-of-principle pellet injector results.** Fisher, P.W.; Fehling, D.T.; Gouge, M.J.; Milora, S.L. Oak Ridge National Lab., TN (USA). 1989. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 13. international symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. Order Number DE90001653. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The tritium proof-of-principle (TPOP) experiment was built by Oak Ridge National Laboratory (ORNL) to demonstrate the feasibility of forming solid tritium pellets and accelerating them to high velocities for fueling future fusion reactors. TPOP used a pneumatic pipe-gun with a 4-mm-i.d. by 1-m-long barrel. Nearly 1500 pellets were fired by the gun during the course of the experiment; about a third of these were tritium or mixtures of deuterium and tritium. The system also contained a cryogenic ^{3}He separator that reduced the ^{3}He level to <0.005%. Pure tritium pellets were accelerated to 1400 m/s. Experiments evaluated the effect of cryostat temperature and fill pressure on pellet size, the production of pellets from mixtures of tritium and deuterium, and the effect of aging on pellet integrity. The tritium phase of these experiments was performed at the Tritium Systems Test Assembly (TSTA) at Los Alamos National Laboratory. About 100 kCi of tritium was processed through the apparatus without incident. 8 refs., 7 figs.

53989 (CONF-891007–20) **Remote maintenance of Compact Ignition Tokamak ex-vessel systems.** DePew, R.E.; Macdonald, D. Oak Ridge National Lab., TN (USA). 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 13. international symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. Order Number DE90001637. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The use of deuterium-tritium (D-T) fuel in the Compact Ignition Tokamak (CIT) will require applying remote handling technology for ex-vessel maintenance and replacement of machine components. Highly activated and contaminated components of the fusion device's auxiliary systems, such as diagnostics and RF heating, must be replaced using remotely operated maintenance equipment in the test cell. Throughout the CIT remote maintenance (RM) studies conducted to date, computer modeling has been used extensively to investigate manipulator access in these complex, tightly packed, and cluttered surroundings. A recent refinement of computer modeling involves the use of an intelligent engineering work station for realtime interactive display of task simulations. This paper discusses the use of three-dimensional (3-D) kinematic computer models of the CIT machines that are proving to be powerful tools in our efforts to evaluate RM requirements. This presentation includes a videotaped simulation of remote replacement of a plasma viewing assembly. The simulation illustrates some of the constraints associated with typical RM activities and the ways in which computer modeling enhances the design process. 1 ref., 3 figs.

53990 (CONF-891007–21) **The control system for the multiple-pellet injector on the Joint European Torus.** Baylor, L.R.; Jernigan, T.C.; Stewart, K.A. Oak Ridge National Lab., TN (USA). [1989]. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 13. international symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. Order Number DE90001626. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

A stand-alone control and data acquisition system for the Oak Ridge National Laboratory (ORNL) multiple-pellet injector installed on the Joint European Torus (JET) has been designed and installed with the injector. This system, which is based on a MicroVAX II computer and a programmable logic controller (PLC), is an upgrade of previous systems designed for ORNL pellet injectors installed on other fusion experiments. The primary control system upgrades are in the user interface, in the automation of sequential injector operation, and in the analysis of the transient data acquired for each pellet fired. The system is integrated into the JET CODAS environment through CAMAC communications modules with customized communications software. Routine operation of the injector is automated and requires no operator intervention. Details of the hardware and software design and the operation of the system are presented in this paper. 4 refs., 3 figs.

53991 (CONF-891007–25) **Particle exhaust schemes in the DIII-D advanced divertor configuration.** Menon, M.M.; Mioduszewski, P.K. Oak Ridge National Lab., TN (USA). 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 13. international symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. Order Number DE90001738. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

For density control in long-pulse operation, the open divertor on the DIII-D tokamak will be equipped with a baffled chamber and a pumping system. The throat of the baffle chamber is sized to provide optimal pumping for the typical plasma equilibrium configuration. Severe limitations on the toroidal conductance of this baffle chamber require the use of in-vessel pumping to achieve the desired particle exhaust of about 25 Torr·l/s. Two separate pumping schemes are considered: an array of titanium getter modules based on the design developed by the Tore Supra team and a cryocondensation pump. The merits and demerits of each scheme are analyzed, and the design considerations introduced by the tokamak environment are brought out. 3 refs., 5 figs.

53992 (CONF-891007–26) **Insulation interlaminar shear strength testing with compression and irradiation.** McManamy, T.J.; Brasier, J.E.; Snook, P. Oak Ridge National Lab., TN (USA). [1989]. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 13. international symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. Order Number DE90001740. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The Compact Ignition Tokamak (CIT) project identified the need for research and development for the insulation to be used in the toroidal field coils. The requirements included tolerance to a combination of high compression and shear and a high radiation dose. Samples of laminate-type sheet material were obtained from commercial vendors. The materials included various combinations of epoxy, polyimide, E-glass, S-glass, and T-glass. The T-glass was in the form of a three-dimensional weave. The first tests were with 50 × 25 × 1 mm samples. These materials were loaded in compression and then to failure in shear. At 345-MPa compression, the interlaminar shear strength was generally in the range of 110 to 140 MPa for the different materials. A smaller sample configuration was developed for irradiation testing. The data before irradiation were similar to those for the larger samples but approximately 10% lower. Limited fatigue testing was also performed by cycling the shear load. No reduction in shear strength was found after 50,000 cycles at 90% of the failure stress. Because of space limitations, only three materials were chosen for irradiation: two polyimide systems and one epoxy system. All used boron-free glass. The small shear/compression samples and some flexure specimens were irradiated to 4×10^9 and 2×10^{10} rad in the Advanced Technology Reactor at Idaho National Engineering Laboratory. A lead shield was used to ensure that the majority of the dose was from neutrons. The shear strength with compression before and after irradiation at the lower dose was determined. Flexure strength and the results from irradiation at the higher dose level will be available in the near future. 7 refs., 7 figs., 2 tabs.

53993 (CONF-891007–27) **ITER [International Thermonuclear Experimental Reactor] reactor building design study.** Thomson, S.L.; Blevins, J.D.; Delisle, M.W. Oak Ridge National Lab., TN (USA). [1989]. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 13. international symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. Order Number DE90001728. Available from NTIS, PC A03/MF A01; OSTI; INIS.

The International Thermonuclear Experimental Reactor (ITER) is at the midpoint of a two-year conceptual design. The ITER reactor building is a reinforced concrete structure that houses the tokamak and associated equipment and systems and forms a barrier between the tokamak and the external environment. It provides radiation shielding and controls the release of radioactive materials to the environment during both routine operations and accidents. The building protects the tokamak from external events, such as earthquakes or aircraft strikes. The reactor building requirements have been developed from the component designs and the preliminary safety analysis. The equipment requirements, tritium confinement, and biological shielding have been studied. The building design in progress requires continuous iteraction with the component and system designs and with the safety analysis. 8 figs.

53994 (CONF-891007–28) **The ORNL fast wave ICRF [Ion Cyclotron Range of Frequencies] antenna for Alcator C-Mod.** Goulding, R.H.; Hoffman, D.J.; Conner, D.L.; Hammonds, C.J.; Ping, J.L.; Riemer, B.W.; Ryan, P.M.; Taylor, D.J.; Wysor, R.B.; Yugo, J.J. Oak Ridge National Lab., TN (USA). [1989]. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 13. international symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. Order Number DE90001969. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A fast wave ICRF antenna is being designed for Alcator C-Mod which is prototypical in many respects of the baseline launcher design for the Compact Ignition Tokamak (CIT). The C-Mod launcher has a single current strap, with a strap and cavity geometry very similar to one quadrant of the CIT launcher, which has four straps in a 2 × 2 configuration. The antenna fits entirely within an 8 in. wide by 25 in. long port and is radially movable over a distance of 15 cm. It will operate at a frequency of 80 MHz for pulse lengths up to 1 s, at a maximum power level of 2 MW, corresponding to a power flux of >1.5 kW/cm^2. The antenna is an end fed double loop configuration in which the current strap is grounded in the middle to provide mechanical support. The design includes a disruption support system which accommodates thermal expansion of the antenna box while supporting large disruption loads. It also includes a novel matching system consisting of an external resonant loop with two shunt capacitors serving as tuning/matching elements. 8 refs., 5 figs., 12 tabs.

53995 (CONF-891007–29) **Design and development of a fast-response ionization gauge controller.** Halliwell, J.W.; Dyer, G.R.; Simpkins, J.E. Oak Ridge National Lab., TN (USA). [1989]. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 13. international symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. Order Number DE90001970. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Fast pressure measurements in the divertor and pump limiter chambers used in magnetic confinement fusion experiments require a system that can respond to a broad range of pressures while maintaining good noise immunity. Available designs of gauge controllers were unable to provide a acceptable noise immunity. A fast ionization gauge controller that can respond to pressure changes in the range from 1×10^{-1} to 2×10^{-5} Torr in less than 10 ms using a Schultz-Phelps gauge assembly has been developed. The Schultz-Phelps gauge provides full coverage of the desired pressure range and is less susceptible to magnetic field interference than other available types of ionization gauges. The gauge controller as designed provides simultaneous readout of three decades of pressure. Major design concerns have been to minimize noise induced by the gauge tube filament drive and noise pickup by the ionization current electrometer. By using DC filament drive, a major shortcoming of available gauge controllers, i.e., 60-Hz pickup caused by filament modulation of the electron current, has been overcome. Second, by locating the electrometer amplifier as close to the Schultz-Phelps gauge as possible, cable-induced noise pickup has been reduced to an acceptable level. Problems encountered in the design and test of the gauge controller and future improvements are discussed. 3 refs., 4 figs.

53996 (CONF-891007–30) **Technology of fast-wave current drive antennas.** Hoffman, D.J.; Baity, F.W.; Goulding, R.H.; Haste, G.R.; Ryan, P.M.; Taylor, D.J.; Swain, D.W.; Mayberry, M.J.; Yugo, J.J. Oak Ridge National Lab., TN (USA). 1989. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 13. international symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. Order Number DE90001972. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The design of fast-wave current drive (FWCD) antennas combines the usual antenna considerations (e.g., the plasma/antenna interface, disruptions, high currents and voltages, and thermal loads) with new requirements for spectral shaping and phase control. The internal configuration of the antenna array has a profound effect on the spectrum and the ability to control phasing. This paper elaborates on these considerations, as epitomized by a proof-of-principle (POP) experiment designed for the DIII-D tokamak. The extension of FWCD for machines such as the International Thermonuclear Engineering Reactor (ITER) will require combining ideas implemented in the POP experiment with reactor-relevant antenna concepts, such as the folded waveguide. 6 refs., 8 figs.

53997 (CONF-891007–32) **Remote maintenance for fusion: Requirements vs technology gap.** Davis, F.C.; Kuban, D.P. Oak Ridge National Lab., TN (USA). [1989]. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 13. international symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. Order Number DE90001962. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Today's remote handling technology was developed in response to the remote maintenance (RM) requirements of the fission community's nuclear fuel recycle process. The needs of the fusion community present new challenges to the remote handling experts of the world. New difficulties are superimposed on the difficulties experienced in maintaining fission processes. Today's technology must be enhanced to respond to the RM needs of these future huge investments. This paper first discusses the current RM needs for fusion based on existing facilities and designs of future machines. It then exposes the gap between these requirements and existing RM technology and recommends ways to extend the state of the art to close this gap.

53998 (CONF-891007–33) **Operation and reliability of a pneumatic hydrogen pellet injection system on the Joint European Torus.** Combs, S.K.; Jernigan, T.C.; Baylor, L.R.; Milora, S.L.; Foust, C.R.; Kupschus, P.; Gadeberg, M.; Bailey, W. Oak Ridge National Lab., TN (USA). [1989]. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 13. international symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. Order Number DE90001961. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

A pneumatic-based, hydrogen isotope pellet injector that was developed at the Oak Ridge National Laboratory for the plasma fueling application on the Joint European Torus (JET) was described at the last Symposium on Fusion Engineering (1987). The injector was installed on JET during 1987 and has since been used in plasma fueling experiments. The injector consists of three independent machine-gun-like mechanisms (nominal pellet sizes of 2.7, 4.0, and 6.0 mm in diameter), and it features repetitive operation (1-5 Hz) for quasi-steady-state conditions (>10 s). An extensive set of injector diagnostics permits evaluation of parameters for each pellet shot, including speed, mass, and integrity. Pellet speeds can be varied but typically range from 1.0 to 1.5 km/s. Over 5000 pellets have been fired with the equipment at JET, including about 2000 pellets shot for plasma fueling experiments. In recent experiments, the system performance has been outstanding, including excellent reproducibility in pellet speed and mass and a reliability of >98% in delivery of pellets to the plasma. 7 refs., 5 figs.

53999 (CONF-891007–34) **Scenarios for ITER [International Thermonuclear Experimental Reactor] steady-state and technology testing operation.** Galambos, J.; Peng, Y-K.M.; Perkins, L.J. Oak Ridge National Lab., TN (USA). [1989]. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 13. international symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. Order Number DE90001966. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Operational scenarios for the International Thermonuclear Experimental Reactor (ITER) steady-state and technology testing phases are identified by trade-offs among wall load, burn time, and divertor heat loads. Steady-state operation with $Q \geq 5$ is limited to wall loads ≥ 0.5 MW/m^2 and injection powers ≥ 100 MW. Even at steady-state wall loads of 0.5 MW/m^2, the divertor heat loads are higher than predicted for the physics phase. For technology testing, hybrid operation (with simultaneous inductive and noninductive current drive) results in a wall load of 0.8 MW/m^2, with injection power of about 100 MW, and a burn time of about 1200 s, with a divertor heat load similar to that of the physics phase. Significant uncertainty exists in our present understanding of the divertor conditions. Should conditions prove to be more favorable than assumed here, the operational windows would open considerably. For factor of $\approx$3 reductions in predicted divertor loads, we show potential steady-state cases at wall loads of 0.8 MW/m^2, injection powers of about 130 MW, and Q near 7. With factors of $\approx$1.5–2.5 reduction in the predicted divertor loads, hybrid technology testing could be accomplished with wall loads of 0.8 MW/m^2 burn times of 1–3 h, and injection powers of 100–150 MW. 5 refs., 3 figs., 2 tabs.

54000 (CONF-891093–3) **Potential applications of an electron cyclotron resonance multicusp plasma source.** Tsai, C.C.; Berry, L.A.; Gorbatkin, S.M.; Haselton, H.H.; Roberto, J.B.; Stirling, W.L. Oak Ridge National Lab., TN (USA). [1989]. 21p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 36. American Vacuum Society national vacuum symposium; Boston, MA (USA); 23-27 Oct 1989. Order Number DE90001358. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

An electron cyclotron resonance (ECR) multicusp plasmatron has been developed by feeding a multicusp bucket arc chamber with a compact ECR plasma source. This novel source produced large (about 25-cm-diam), uniform (to within $\pm$10%), dense (>10^{11}-cm^{-3}) plasmas of argon, helium, hydrogen, and oxygen. It has been operated to produce an oxygen plasma for etching 12.7-cm (5-in.) positive photoresist-coated silicon wafers with uniformity within $\pm$8%. Results and potential applications of this new ECR plasma source for plasma processing of thin films are discussed. 21 refs., 10 figs.

54001 (CONF-8909210–3) **Independent-particle model for fusion in cluster impact.** Crawford, O.H. Oak Ridge National Lab., TN (USA). [1989]. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San

Sebastian (Spain); 4-7 Sep 1989. Order Number DE90001338. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Theory is presented in an independent-particle model for the fusion yields from impact of accelerated $(D_2O)_n^+$ clusters on TiD. It is assumed that deuterons from an incident cluster penetrate the medium independently of each other. Comparison is made with the recent experiment of Beuhler, Friedlander, and Friedman. The measured yields (fusion events per incident cluster) are many orders of magnitude higher than the calculated ones (based on this theory). This shows that cooperative effects, involving the cluster, are crucial to interpretation of the reported results. The calculations illustrate the necessity of rigorously excluding low-mass deuterium-containing ions from the incident beam in such an experiment. 7 refs., 1 fig.

54002 (DOE/ER–0313/6) **Fusion reactor materials: Semiannual progress report for the period ending March 31, 1989.** Oak Ridge National Lab., TN (USA). 1989. 423p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. (ORNL/M–919). Order Number DE90000976. Available from NTIS, PC A17/MF A01; OSTI; INIS; GPO Dep.

This paper discuses the following topics on fusion reactor materials: irradiation, facilities, test matrices, and experimental methods; dosimetry, damage parameters, and activation calculations; materials engineering and design requirements; fundamental mechanical behavior; radiation effects; development of structural alloys; solid breeding materials; and ceramics.

54003 (DOE/ER/53222–100) **[High beta tokamak research]: Progress report, November 8, 1987–July 1, 1989.** Columbia Univ., New York, NY (USA). Plasma Physics Lab. [1989]. 45p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-86ER53222. Order Number DE90002135. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Our activities on High Beta Tokamak Research during the past 20 months of the present grant period can be divided into six areas: reconstruction and modeling of high beta equilibria in HBT; measurement and analysis of MHD instabilities observed in HBT; measurements of impurity transport; diagnostic development on HBT; numerical parameterization of the second stability regime; and conceptual design and assembly of HBT-EP. Each of these is described in some detail in the sections of this progress report.

54004 (ETDE-IT–89-01) **Liquid nitrogen cooling system for FTU Tokamak machine.** Migliori, S.; Bettinali, L.; Gasparotto, M.; Pizzuto, A. ENEA, Frascati (Italy). Centro Ricerche Energia. Jul 1988. 5p. (CONF-880736–7: 12. international cryogenic engineering conference and exhibition, Southampton (UK), 12-15 Jul 1988). Order Number DE89793195. Available from NTIS (US Sales Only), PC A02/MF A01.

This report lists the main parameters of the FTU machine and describes the function of its cryogenic system and the system's principal components - valves, phase separator, pumps and control system. The basic idea in the design of the FTU (Frascati Tokamak Upgrade) machine is to try to reach a range of plasma parameters of great thermonuclear interest within a reasonable financial effort. In the FTU, the good energy confinement properties of a compact tokamak with a medium high toroidal field: 8 T, are combined with the strong plasma heating obtained by injecting up to 8 MW of radiofrequency power in the lower hybrid "electron mode" (8 GHz). The basic mechanical structure of the machine is provided by the monolithic toroidal magnet supporting the vacuum chamber and the poloidal field windings. The machine is kept, during operation, at liquid nitrogen temperature (-196 degrees centigrade), to minimize the power consumption in the magnet coils and the poloidal field windings and to take advantage of the higher mechanical properties of the structural materials (stainless steel and copper) at cryogenic temperature. Liquid nitrogen was selected as the coolant because of its high latent heat of vaporization, its relatively low cost and ease of handling. The liquid nitrogen plant was ordered from the firm of RIVOIRA SpA (Italy) in July 1986. The plant has been completely installed and final testing is under way. The first cooling of the machine at liquid nitrogen temperature is expected to take place in spring 1989.

54005 (IPPJ-REV–3, pp. 94-98) **Tritium safety and environmental considerations in fusion studies at IPPJ.** Obayashi, Haruo (Nagoya Univ. (Japan). Inst. of Plasma Physics); Sakuma, Yoichi; Amano, Hiroshi. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. (CONF-881190–: 3. Japan-US workshop on tritium radiobiology and health physics, Kyoto (Japan), 8-10 Nov 1988). In *Proceedings of the third Japan-US workshop P-133 on tritium radiobiology and health physics. 9. international symposium of Radiation Biology Center.* Order Number DE90705927. Available from NTIS (US Sales Only), PC A14/MF A01.

In preparing the next-step experimental plans at IPPJ, considerations on the tritium safety and other environmental issues have been developed. The background quantities such as natural radiation levels and tritium concentrations have been systematically measured on the prospective site and its surroundings. Implications of the planned methods of radiation monitoring and tritium safe handling are also discussed. (author).

54006 (ORNL/FTR–3018) **[Properties of candidate materials for the ITER [International Thermonuclear Experimental Reactor]]: Foreign trip report, August 20, 1988–August 27, 1988.** Davis, J.W. Oak Ridge National Lab., TN (USA). 12 Sep 1988. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90002137. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Properties of candidate materials for the ITER were discussed in detail at this meeting. It was recommended that the ITER designers used type 316L stainless steel for the first wall and blanker structures but also conduct the design studies with PCA and a low activation austenitic steel as well.

54007 (ORNL/FTR–3184) **[Evaluation of graphite as first-wall material and development of first-wall engineering for next large fusion devices]: Foreign trip report, January 31, 1989–February 9, 1989.** Davis, J.W. Oak Ridge National Lab., TN (USA). 24 Feb 1989. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90002142. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report summarizes the results of two workshops. The first workshop held in Tokyo was intended to be an engineering workshop, while the Hokkaido meeting was intended to be a materials research meeting. It was recommended at the Hokkaido meeting that a stronger interface be created between the designers, material suppliers, and the researchers in order to focus the near-term research towards the next-generation machines.

54008 (ORNL/FTR–3409) **[Radiation damage correlation for fusion conditions]: Foreign trip report, September 25, 1989–October 3, 1989.** Grossbeck, M.L. Oak Ridge National Lab., TN (USA). 16 Oct 1989. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90001208. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The workshop consisted of formal presentations and discussions by 39 invited participants from 11 countries. The theme of the workshop was the status of techniques for correlating fusion reactor and accelerator-generated data with those expected of a fusion reactor neutron spectrum. Several papers addressed the nature of cascades induced by 14 MeV neutrons. Still others supported such studies by theoretical investigations of high-energy neutron damage. Other presentations, such as the traveler's presentation, addressed the macroscopic aspects of neutron irradiation effects, such as swelling, irradiation creep, and mechanical properties. Additional presentations addressed theoretical aspects of helium embrittlement and transmutation products in general.

54009 (ORNL/TM–11217) **Stored energy in fusion magnet materials irradiated at low temperatures.** Chaplin, R.L.; Kerchner, H.R.; Klabunde, C.E.; Coltman, R.R. Oak Ridge National Lab., TN (USA). Aug 1989. 39p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90001856. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

During the power cycle of a fusion reactor, the radiation reaching the superconducting magnet system will produce an accumulation of immobile defects in the magnet materials. During a subsequent warm-up cycle of the magnet system, the defects will become mobile and interact to produce new defect configurations as well as some mutual defect annihilations which generate heat-the release

of stored energy. This report presents a brief qualitative discussion of the mechanisms for the production and release of stored energy in irradiated materials, a theoretical analysis of the thermal response of irradiated materials, theoretical analysis of the thermal response of irradiated materials during warm-up, and a discussion of the possible impact of stored energy release on fusion magnet operation 20 refs.

54010 (ORNL/TM–11253) **Construction and initial operation of the Advanced Toroidal Facility.** Bell, G.L.; Bell, J.D.; Benson, R.D.; Bigelow, T.S.; Chipley, K.K.; Colchin, R.J.; Cole, M.J.; Crume, E.C.; Dunlap, J.L.; England, A.C.; Glowienka, J.C.; Goulding, R.H.; Harris, J.H.; Hillis, D.L.; Hiroe, S.; Horton, L.D.; Howe, H.C.; Isler, R.C.; JerniganOak Ridge National Lab., TN (USA). Aug 1989. 37p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90000978. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The Advanced Toroidal Facility (ATF) torsatron was designed on a physics basis for access to the second stability regime and on an engineering basis for independent fabrication of high-accuracy components. The actual construction, assembly, and initial operation of ATF are compared with the characteristics expected during the design of ATF. 31 refs., 19 figs., 2 tabs.

54011 (PPPL–2652) **Computation of magnetic coordinates and action-angle variables.** Reiman, A.H.; Pomphrey, N. Princeton Univ., NJ (USA). Plasma Physics Lab. 4 Oct 1989. 39p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03073. Order Number DE90001864. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

We have developed a new algorithm for calculating magnetic surfaces and coordinates for a given three-dimensional magnetic field. The algorithm serves also to solve the equivalent problem of computing invariant tori and action-angle variables for a one-dimensional time-dependent numerically specified Hamiltonian (or a two-dimensional time-independent Hamiltonian). Our approach combines features of both iterative and trajectory following methods. This allows us to overcome the inefficiency of trajectory following methods near low order rational surfaces, while retaining some of the robustness of these methods. 26 refs., 8 figs., 1 tab.

54012 (UCRL–101099) **Analysis of quench-vent pressures for present design of ITER [International Thermonuclear Experimental Reactor] TF [toroidal field] coils.** Slack, D.S. Lawrence Livermore National Lab., CA (USA). 20 Sep 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. (CONF-891007–10: 13. international symposium on fusion engineering, Knoxville, TN (USA), 2-6 Oct 1989). Order Number DE90001165. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The International Thermonuclear Experimental Reactor (ITER) is a new tokamak design project with joint participation from Japan, the European Community, the Union of the Soviet Union, and the United States. This paper examines the effects of a quench within the toroidal field (TF) coils based on current ITER design. It is a preliminary, rough analysis. Its intent is to assist ITER designers while more accurate computer codes are being developed and to provide a check against these more rigorous solutions. Rigorous solutions to the quench problem are very complex involving three-dimensional heat transfer, extreme changes in heat capacities and copper resistivity, and varying flow dynamics within the conductors. This analysis addresses all these factors in an approximate way. The result is much less accurate than a rigorous analysis. Results here could be in error as much as 30 to 40 percent. However, it is believed that this paper can still be very useful to the coil designer. Coil pressures and temperatures vs time into a quench are presented. Rate of helium vent, energy deposition in the coil, and depletion of magnetic stored energy are also presented. Peak pressures are high (about 43 MPa). This is due to the very long vent path length (446 m), small hydraulic diameters, and high current densities associated with ITER's cable-in-conduit design. The effects of these pressures as well as the ability of the coil to be self protecting during a quench are discussed. 3 refs., 1 fig., 3 tabs.

54013 (UCRL–101131) **Floating data acquisition system for microwave calorimeter measurements on MTX.** Sewall, N.R. Lawrence Livermore National Lab., CA (USA). 13 Sep 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. (CONF-891007–6: 13. international symposium on fusion engineering, Knoxville, TN (USA), 2-6 Oct 1989). Order Number DE90000816. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

A microwave calorimeter has been designed for making 140-GHz absorption measurements on the MTX. Measurement of the intensity and spatial distribution of the FEL-generated microwave beam on the inner wall will indicate the absorption characteristics of the plasma when heated with a 140 GHz FEL pulse. The calorimeter works by monitoring changes of temperature in silicon carbide tiles located on the inner wall of the tokamak. Thermistors are used to measure the temperature of each tile. The tiles are located inside the tokamak about 1 cm outside of the limiter radius at machine potential. The success of this measurement depends on our ability to float the data acquisition system near machine potential and isolate it from the rest of the vault ground system. Our data acquisition system has 48 channels of thermistor signal conditioning, a multiplexer and digitizer section, a serial data formatter, and a fiber-optic transmitter to send the data out. Additionally, we bring timing signals to the interface through optical fibers to tell it when to begin measurement, while maintaining isolation. The receiver is an HP 200 Series computer with a serial data interface; the computer provides storage and local display for the shot temperature profile. Additionally, the computer provides temporary storage of the data until it can be passed to a shared resource management system for archiving. 2 refs., 6 figs.

54014 (UCRL–101136) **Performance of cable-in-conduit conductors in ITER [International Thermonuclear Experimental Reactor] toroidal field coils with varying heat loads.** Kerns, J.A.; Wong, R.L. Lawrence Livermore National Lab., CA (USA). 20 Sep 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. (CONF-891007–15: 13. international symposium on fusion engineering, Knoxville, TN (USA), 2-6 Oct 1989). Order Number DE90001514. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The toroidal field (TF) coils in the International Thermonuclear Experimental Reactor (ITER) will operate with varying heat loads generated by ac losses and nuclear heating. The total heat load is estimated to be 2 kW per TF coil under normal operation and can be higher for different operating scenarios. Ac losses are caused by ramping the poloidal field (PF) for plasma initiation, burn, and shutdown; nuclear heating results from neutrons that penetrate into the coil past the shield. Present methods to reduce or eliminate these losses lead to larger and more expensive machines, which are unacceptable with today's budget constraints. A suitable solution is to design superconductors that operate with high heat loads. The cable-in-conduit conductor (CICC) can operate with high heat loads. One CICC design is analyzed for its thermal performance using two computer codes developed at LLNL. One code calculates the steady state flow conditions along the flow path, while the other calculates the transient conditions in the flow. We have used these codes to analyze the superconductor performance during the burn phase of the ITER plasma. The results of these analyses give insight to the choice of flow rate on superconductor performance. 4 refs., 5 figs.

54015 (UCRL–101241) **Program CICC flow and heat transfer in cable-in-conduit conductors.** Wong, R.L. Lawrence Livermore National Lab., CA (USA). 20 Nov 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. (CONF-891007–14: 13. international symposium on fusion engineering, Knoxville, TN (USA), 2-6 Oct 1989). Order Number DE90001519. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Computer program CICC has been written for use in the thermofluids design of superconducting magnets for tokamak reactors, which use forced-flow, helium-cooled, cable-in-conduit conductors (CICC). In addition to background heat loads that vary with space and time, these superconductors can develop normal zones that generate electrical resistance heat. Program CICC models the transient thermodynamic and fluid-dynamic system response to background heating and normal-zone propagation in the superconductor. The computational algorithm described in this paper couples a one-dimensional, compressible pipe-flow model (including flow

choking) with two-dimensional, axisymmetric heat-conduction models of the superconductor cable, the conduit, and the epoxy-conduit insulation. National Institute of Standards and Technology helium properties are used. The model is verified by comparison with measured temperature and pressure profiles from thermal expulsion experiments. 10 refs., 9 figs.

54016 Fiber optic pressure measurement during an electromagnetic pulse. Hastings, R. (Los Alamos National Lab., NM (USA)); Leonard, E.; Powell, J. pp. 443 of OSA conference on lasers and electro-optics (1989 Technical Digest series). Optical Society of America, Washington, DC (1989). (CONF-890423–: CLEO '89: conference on lasers and electro optics, Baltimore, MD (USA), 24-28 Apr 1989).

Technical Paper WE2.

The fiber-optic Hopkinson bar technique was modified significantly to measure the development of pressure inside a vessel during the burst from a fast burst reactor. The pressure measurement required an observation of the actual pressure buildup during a burst. The experiments are being performed at the Los Alamos National Laboratory Godiva IV fast burst reactor. Godiva IV has a 30-σs burst width and produces 1.8 MJ/burst (6 X 10^{16} fissions). The pressure vessel is a graphite fiber composite vessel. The fiber optic material is a high purity single-mode fused 5-μm core fiber. The fiber is epoxied around the circumference of the graphite vessel. The stress induced in the vessel walls causes a slight stretching of the optical fiber, causing constructive and destructive interference which produces fringes when a He-Ne laser light is passed through the fibers and allowed to recombine via an interferometer. A measurement of these fringes allows one to deduce the pressure history inside the vessel.

54017 Railgun rail gouging by hypervelocity sliding contact. Barker, L.M. (Sandia National Labs., Albuquerque, NM (USA)); Trucano, T.G.; Susoeff, A.R. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics (USA),* 25(1): 83-87 (Jan 1989).

A description is given of a recently resolved mechanisms of gouging which occurs during hypervelocity sliding contact between two materials. A parameter study based on computer modeling of the gouging mechanism is presented in which gouging velocity thresholds are determined for several combinations of sliding materials. Materials which can gouge each other are found to do so only within a certain range of velocities. Related calculations of gaseous material ahead of railgun projectiles are also presented. Gun bore gouging experience with the Lawrence Livermore National Laboratory railgun project is reviewed.

54018 Continuous measurements of in-bore projectile velocity. Asay, J.R. (Sandia National Labs., Albuquerque, NM (USA)); Konrad, C.H.; Hall, C.A.; Shahinpoor, M.; Hickman, R. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics (USA),* 25(1): 46-51 (Jan 1989).

The application of velocity interferometry to the continuous measurement of in-bore projectile velocity in a small-bore three-stage railgun is described. These measurements are useful for determining projectile acceleration and for evaluating gun performance. The launcher employed in these studies consists of a two-stage light gas gun used to inject projectiles into a railgun for additional acceleration. Results obtained for projectile velocities to 7.4 km/s with the two-stage injector are reported and potential improvements for railgun applications are discussed.

54019 High velocity contact properties. Barber, J.P. (IAP Research, Inc., 2763 Culver Ave., Dayton, OH (US)); Maas, B.L. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics (USA),* 25(1): 72-74 (Jan 1989).

Electrical contacts have not been experimentally investigated at velocities above a few hundred meters per second. In this paper the authors describe a ballistic technique which can be used to measure friction coefficient and contact resistance at velocities up to several kilometers per second. The theoretical basis of the technique is described and the experimental hardware is presented.

54020 Electrothermal accelerators. Driga, M.D. (Texas Univ., Austin, TX (USA). Center for Electromechanics); Ingram, M.W.; Weldon, W.F. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics (USA),* 25(1): 147-152 (Jan 1989).

In electrothermal (ET) guns, the projectile acceleration is governed by gas dynamics as in explosively-driven guns. In a conventional gun, however, both the energy for heating and the material to be heated are contained in the solid propellant. Electrothermal launchers allow an external electric power supply to be used to provide the necessary energy; hence, lower atomic weight propellants may be used and heated to higher temperatures while maintaining a tailored acceleration profile. Important improvements in hypervelocity performance and barrel degradation can be obtained by controlling the electric discharges via power conditioning. Complex voltage and current waveforms are achieved using complex power conditioning systems, since the existing power supplies do not conform to ET gun requirements. This paper advances the concept of a single element power supply for ET guns, showing that compulsator-type machines with waveform flexibility (pulse shaping capability) can satisfy all the ET gun power supply and conditioning requirements while maintaining a high efficiency and los mass. Additionally, compulsators are suitable for repetitive-fire applications. Also described in the paper is a system of homopolar generators (HPGs) and inductors for laboratory applications.

54021 Summary of recent results form the JAERI/US fusion neutronics phase 1 experiments. Nakamura, T.; Abdou, M.A. *Transactions of the American Nuclear Society (USA),* 52: 106-107 (1986). (CONF-860610–Summs.: American Nuclear Society annual meeting, Reno, NV (USA), 15-20 Jun 1986).

The tritium breeding ration (TBR) in a fusion blanket is one of the most important parameters to be considered in the conceptual design of fuel-self-feeding deuterium-tritium (D-T) reactors. There are many factors, both physics and engineering, that affect the TBR value in a design. Efforts in the neutronics area are to provide data needed for identifying and selecting materials and configurations that achieve an optimal TBR, and to improve the accuracy of neutronics predictions. A program is in progress on integral neutronics experiments and their analyses in the collaboration between the Japan Atomic Energy Research Institute (JAERI) and the US Department of Energy. The objectives of the program are: 1. To provide experimental data needed to determine the accuracy, guide the development, and establish the validity of the calculational methods and nuclear data bases. 2. To provide experimental data to assist in the selection, from a neutronics point of view, of configurations and materials for candidate blanket designs. The collaboration program was planned for two phases. Phase I experiments that have just been completed focused on simple blanket assemblies. Phase II experiments, scheduled to start during the summer of 1986, will be directed at more complex material arrangements and geometrical configurations. 3 refs., 2 figs.

54022 Analysis and intercomparison for phase I experiments at FNS [fusion neutron source]. Youssef, M. (Univ. of California, Los Angeles (USA)); Jung, J.; Gung, C.; Abdou, M.; Nakagawa, M.; Mori, T.; Kosako, K.; Hasegawa, A.; Nakamura, T. *Transactions of the American Nuclear Society (USA),* 52: 107-109 (1986). (CONF-860610–Summs.: American Nuclear Society annual meeting, Reno, NV (USA), 15-20 Jun 1986).

The phase I integral experiments of the Japan Atomic Energy Research Institute (JAERI)/US collaborative program on fusion breeder neutronics, which were carried out at the Fusion Neutron Source (FNS) Facility at JAERI, ranged from a deuterium-tritium neutron source characterization experiment, tritium production rate (TPR) measurements in a reference Li_2O assembly, first-wall experiments with and without coolant stimulation, and beryllium neutron multiplier experiments in various configurations. The phase II experiments of the program are planned to be carried out during FY1986-1987 when the system specifications (geometrical arrangement, material selection, etc.) are chosen to give closer simulation to the fusion reactor environment (spectra). Both the United States and JAERI have independently analyzed phase I experiments using their own data bases and codes. Analytical predictions obtained by both countries were compared to measured values. The main objective

of the intercomparison is to determine the accuracy, guide the development, and establish the validity of present computational methods and nuclear data bases in predicting key fusion blanket design parameters (e.g., TPR, heating rate, etc.) and to evaluate the overall uncertainties (both analytical and experimental) associated with these parameters. 7 refs., 2 figs.

54023 Measured neutron parameters for phase I experiments at the FNS [fusion neutron source] facility. Maekawa, H.; Nakamura, T.; Oyama, Y.; Ikeda, Y.; Yamaguchi, S.; Tsuda, K.; Oishi, K.; Porges, K.G.; Bennett, E.F.; Yule, T.J.; Dilorio, D.J. *Transactions of the American Nuclear Society (USA),* 52: 109-110 (1986). (CONF-860610–Summs.: American Nuclear Society annual meeting, Reno, NV (USA), 15-20 Jun 1986).

The objective of the phase I experiments of the Japan Atomic Energy Research Institute (JAERI)/US collaborative program on fusion neutronics is to acquire neutronic data on a large-scale system from the simple to the composite in order to examine the overall accuracy of nuclear calculations for the fusion blanket concept, by making the most use of the resources available at hand. The Fusion Neutron Source (FNS) Facility of JAERI is used in this program. In phase I experiments, the target room is assumed as the plasma chamber of a fusion reactor, and its thick shield wall as the blanket section. Neutrons from the burning plasma are simulated by those from the rotating neutron target (RNT) situated at the center of the cavity. A blanket test module is imbedded in a large experimental hold in the shielding wall. The room, RNT, and test module are treated in a set in the experimental arrangement. Once the characteristics were determined for the input neutrons entering the test region, the neutronic quantities can be measured for various configurations parametrically. The test module is composed by assembling blocks; the block structure makes it easy to modify the system and to select the detector locations. Lithium oxide of natural composition is used as the breeding material. The configuration can be changed by placing the constituent materials in front of, behind, or inside the basic plain system. Measurements were performed on absolute neutron yield calibration, angular and spatial distributions, and neutron spectra for both direct and reflected components. 3 refs., 1 fig., 1 tab.

54024 LN_2 cyclic cooling considerations of fusion ignition devices. Dabiri, A.E. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society (USA),* 52: 138-139 (1986). (CONF-860610–Summs.: American Nuclear Society annual meeting, Reno, NV (USA), 15-20 Jun 1986).

Three preconceptual design studies have been under way in the United States for compact fusion ignition devices, all of which utilize copper magnets for toroidal field (TF) and poloidal field coils. The proposal is to operate the magnets at liquid nitrogen temperature to minimize the power requirements for the magnets. During each operating pulse, the temperature of he magnet systems is allowed to increase; no active cooling is provided during the pulse. One of the design requirements calls for cooldown between full-power pulses in some reasonable time to proved the capability for some reasonable number of operating pulses per day. A number of devices such as Alcator-A and -C have operated around liquid nitrogen temperature, but these machines have much shorter pulses and produce no neutrons. Therefore, the temperature rise during each pulse is modest, and the cooldown is less of a problem than for an ignited device with burn times of several seconds. The purpose of this study is to develop a simple model to calculate the cooldown rate of a magnet with various cooling surface configurations. The results will be useful in developing a configuration to provide the desired cooling time between pulses, which should be ~1 h or less. This analysis was applied to the inner leg of the TF coil of Ignitor, one of the ignition devices under study. The inner leg is analyzed mainly because it carries higher current densities than the outer leg and the cooling surface area is more restricted. Four cooling configuration options were studies. Here the result are reported of the most practical option in which the cooling channel is inside the TF coil. 3 refs., 1 fig., 1 tab.

54025 Plasma armature formation in high-pressure, high-velocity hydrogen. Hawke, R.S. (Lawrence Livermore National Lab., CA (USA)); Susoeff, A.R.; Asay, J.R.; Hall, C.A.; Konrad, C.H.; Hickman, R.J.; Sauve, J.L. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics (USA),* 25(1): 219-222 (Jan 1989).

The use of a two-stage light-gas gun (2SLGG) as a preaccelerator in combination with a railgun is expected to significantly reduce barrel ablation and improve overall performance. In particular, the use of a hydrogen 2SLGG provides injection velocities of 6 to 8 km/s and a pure hydrogen environment immediately behind the projectile as it enters a railgun. To continue acceleration of the projectile, a plasma armature must be formed. The authors explored two methods of converting a portion of the fast-moving hydrogen gas into a plasma armature capable of supporting currents exceeding 100 κA. They report on the results of these studies. This work is part of STARFIRE, the joint Sandia National Laboratories/Lawrence Livermore National Laboratory project to develop a hypervelocity railgun.

99 GENERAL AND MISCELLANEOUS

Refer also to citation(s) 52277

54026 (N–89-23528, pp. 281-299) **Orbital debris environment and data requirements.** Kessler, D.J. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. May 1989. (NASA-CP–3035-PT-1;L–16575-PT-1;NAS–1.55:3035-PT-1;CONF-8806434–: NASA/SDIO space environmental effects on materials workshop, Hampton, VA (USA), 28 Jun - 1 jul 1988). In *NASA/SDIO Space Environmental Effects on Materials Workshop, part 1.* Available from NTIS, PC A16/MF A01.

Orbital debris is already a major design consideration for Space Station Freedom and is becoming important to the design of unmanned spacecraft. Mathematical models predict the environment will increase with time. The amount it increases is dependent on future operations in space, and how these operations are conducted. Therefore, it is important to understand the sources of debris and which operations will minimize debris generation. This requires that debris be monitored. Currently, NASA plans to have an operational capability to monitor 1 cm debris at 500 km by 1991. However, there are currently no plans to monitor the environment of smaller debris which will be important to future spacecraft design.

9901 Management

Refer also to citation(s) 52471, 52716, 54076

9902 Mathematics and Computers

Refer also to citation(s) 51711, 51712, 51717, 51757, 51769, 51786, 51963, 52133, 52134, 52155, 52176, 52177, 52203, 52237, 52238, 52239, 52240, 52256, 52257, 52258, 52259, 52260, 52262, 52263, 52264, 52265, 52268, 52270, 52271, 52273, 52274, 52280, 52299, 52327, 52334, 52335, 52336, 52337, 52343, 52426, 52521, 52661, 52736, 52833, 52848, 52857, 52868, 52869, 52872, 52873, 52875, 52876, 52880, 52906, 52949, 52989, 52997, 53000, 53003, 53113, 53115, 53116, 53123, 53207, 53208, 53218, 53415, 53662, 53731, 53989, 54078

54027 (AD-A–208739/3/XAB) **PASM parallel processing system: Design, simulation, and image-processing applications. Volume 1. Final report, 1 January 1986-31 December 1989.** Kuehn, J.T. Purdue Univ., Lafayette, IN (USA). School of Electrical Engineering. 31 Dec 1989. 394p. Available from NTIS, PC A17/MF A01.

Advances in device and packaging technologies are producing incremental gains in the performance of computer systems. However, these gains are being more than offset by new applications having a need to process large data sets, a need for real-time computation, or other requirements which make them prohibitively expensive to perform on conventional computer systems. This has forced computer architects to consider parallel/distributed computer designs. In Part I of this thesis, the strengths and weaknesses of a variety of existing and proposed parallel computer designs are examined. These characteristics are used to motivate and support the design decisions made for a particular parallel computer architecture, PASM. It is PASM that is the primary focus of the work in this thesis.

54028 (AD-A–209023/1/XAB) **Video Analysis Transputer Array (VATA).** Symanski, J.J.; Bromley, K.; Henderson, T. Naval Ocean Systems Center, San Diego, CA (USA). 19 Aug 1988. 10p. Available from NTIS, PC A02/MF A01.

Pub. in Proceedings of the SPIE Annual International Technical Symposium on Optical and Optoelectronic Applied Science and Engineering (32nd), Vol. 977-34(14-19 Aug 1988).

This paper presents (a) an overview of the Inmos transputer and its use in parallel arrays for image processing, (b) a functional block-level description of IBM-AT-compatible boards for signal/image processing research using transputers with reconfigurable interconnection topologies, and (c) an overview of the OCCAM and C programming tools for placing parallel algorithms onto such a processor. The hardware consists of two custom printed-circuit boards (and two commercially available boards) within an IBM-AT host. The first provides a flexible input/output interface between a general-purpose high-speed input-data bus and the transputer array. The second contains 32 transputers and 4 programmable crossbar-switch interconnection chips. Several copies of the second board can be cascaded (or even partially-unpopulated) to provide for an arbitrary number of transputer chips. Each one of these boards will perform about 128 million Whetstones or, for highly regular algorithms, a sustained 48 MFLOPS.

54029 (AD-A–209117/1/XAB) **Efficient lazy data structures on a data-flow machine. Technical report.** Heller, S.K. Massachusetts Inst. of Tech., Cambridge, MA (USA). Lab. for Computer Science. Feb 1989. 107p. (MIT/LCS/TR–438). Available from NTIS, PC A06/MF A01.

Eager interpreters are able to exploit vast parallelism, yet lazy interpreters have more desirable termination properties. The author proposes lazy data structures, an extension to the dataflow language Id, to support a combination of eager and lazy evaluation. The describes the semantics of lazy data-structures, as well as efficient implementation on the Tagged-Token Dataflow Architecture and the Monsoon Explicit Token Store Machine. He develop support for lazy data-structures in the language, the compiler, the run-time system, the interpreter, and the proposed hardware; and demonstrate the effectiveness of the construct as well as the limitations.

54030 (AD-A–209132/0/XAB) **Parallel vision algorithms. Annual technical report No. 2, 1 October 1987-28 December 1988.** Ibrahim, H.A.; Kender, J.R.; Brown, L.G. Columbia Univ., New York, NY (USA). Dept. of Computer Science. Jan 1989. 81p. (CUCS–415-89). Available from NTIS, PC A05/MF A01.

This Second Annual Technical Report covers the project activities during the period from October 1, 1987 through December 31, 1988. The objective of this project is to develop and implement, on highly parallel computers, vision algorithms that combine stereo, texture, and multi-resolution techniques for determining local surface orientation and depth. Such algorithms can serve as front-end components of autonomous land-vehicle vision systems. During the second year of the project, efforts concentrated on the following: first, implementing and testing on the Connection Machine the parallel programming environment that will be used to develop, implement and test our parallel vision algorithms; second, implementing and testing primitives for the multi-resolution stereo and texture algorithms, in this environment. Also, efforts were continued to refine techniques used in the texture algorithms, and to develop a system that integrates information from several shape-from-texture methods. This report describes the status and progress of these efforts. The authors describe first the programming environment implementation, and how to use it. They summarize the results for multi-resolution based depth-interpolation algorithms on parallel architectures. Then, they present algorithms and test results for the texture algorithms. Finally, the results of the efforts of integrating information from various shape-from-texture algorithms are presented.

54031 (AD-A–209265/8/XAB) **Non-rectangular sampling plan for estimating steady-state means. Technical report.** Glynn, P.W. Stanford Univ., CA (USA). Dept. of Operations Research. Aug 1988. 15p. (TR–29). Available from NTIS, PC A03/MF A01.

The method of multiple replicates is frequently used by simulators to estimate the steady-state mean of a stochastic simulation. One important advantage of this approach is that it is easily adapted to a parallel computer. Unfortunately, the method of multiple replicates is quite sensitive to contamination by initial bias. In this paper, a new type of sampling plan is described. It retains the replication flavor, yet attenuates the bias problem. It is shown that the new method reduces mean square error relative to conventional multiple replicates for problems in which the initial transient decays slowly.

54032 (AD-A–209325/0/XAB) **Expert systems and command, control, and communication system acquisition. Master's thesis.** Minnema, J.E. Naval Postgraduate School, Monterey, CA (USA). Mar 1989. 103p. Available from NTIS, PC A06/MF A01.

This thesis examines the organizational causes of the Department of Defense's (DoD) inability to acquire working defense systems. One major cause of this is identified as a lack of a sufficient number of trained and experienced acquisition personnel. An examination of the definitions of Decision Support and Expert Systems is made to determine their suitability for application to this problem. The information-system framework of Gorry and Scott Morton is used to structure the acquisition problem. The DoD acquisition problem is found to be a good candidate for the application of expert systems. An expert-system architecture is developed to provide acquisition personnel both technical and management support. Use of a central mainframe, connected to the Defense Data Network, will provide nationwide access, with centralized control of the knowledge base. The architecture allows for the incorporation of existing conventional software under expert software control. In order to reduce development cost and time, the use of existing DoD manuals as the knowledge base, is proposed. A prototype module, utilizing the M.1 expert shell and DoD Manual 4245.7-M and NAVSO P-6071 is developed to prove the feasibility of this approach.

54033 (AD-A–209364/9/XAB) **Fault-tolerant computer architecture modeling and analysis. Final technical report, August 1985-August 1988.** Kastner, M.P.; Dunham, S.R.; Pattipati, K.R.; Stueve, J.M.; Kramer, L.C. ALPHATECH, Inc., Burlington, MA (USA). Feb 1989. 313p. Available from NTIS, PC A14/MF A01.

This document is the final report. It describes a three-year research effort to develop an engineering tool capable of supporting design and analysis of large-scale, parallel, fault-tolerant computer architectures (FTCAs). The tool, a software package called Computer-Aided Performance and Reliability Evaluation System (CAPRES), allows an FTCA designer or FTCA-design evaluator to predict, by analytical means, the performance, reliability, and performability of candidate computer architectures executing candidate workloads, rather than requiring costly simulation or prototype testing for such prediction, as is currently the case. The analytic capability of CAPRES will make its most important contribution early in the system engineering cycle, when many candidate designs may appear feasible and the best is far from clear. Designers using CAPRES will be able to examine in a matter of hours or days alternatives that today take weeks or months to assess using conventional methods.

54034 (AD-A–209395/3/XAB) **Northeast Artificial Intelligence Consortium annual report, 1987. Volume 1. Executive summary. Interim report, December 1986-December 1987.** Weiss, V.; Brule, J.F. Syracuse Univ., NY (USA). Mar 1989. 38p. Available from NTIS, PC A03/MF A01.

See also Volume 2, Part A, AD-A208 344.

The Northeast Artificial Intelligence Consortium (NAIC) purpose is to conduct pertinent research in artificial intelligence and to perform activities ancillary to this research. The topics covered in general are: versatile expert system for equipment maintenance, distributed AI for communications system control, automatic photo interpretation, time-oriented problem solving, speech understanding systems, knowledge base maintenance, hardware architectures for very large systems, knowledge-based reasoning and planning, parallel structural, and optimal techniques in vision, and a knowledge acquisition, assistance, and explanation system.

54035 (AD-A–209443/1/XAB) **Parallel processing of central-difference transient analysis for three-dimensional nonlinear framed structures.** Hajjar, J.F.; Abel, J.F. Cornell Univ., Ithaca, NY (USA). Mathematical Sciences Inst. 1989. 9p. Available from NTIS, PC A02/MF A01.

Pub. in Communications in Applied Numerical Methods, Vol. 5, 39-46(1989).

The central difference algorithm is a simple but effective time-integration algorithm suitable for parallel processing. This paper discusses the development and implementation of the method for the fully nonlinear, transient dynamic analysis of three-dimensional framed structures. A data structure is presented in which only one nearest-neighbor communication is required per time step, and potentially little overhead is incurred for the parallel implementation. Because this explicit method is only conditionally stable, the large disparity of natural vibrational frequencies of framed structures indicates that central difference analysis is more useful for applications having short-duration loading. An example is presented indicating the speed-up and efficiency of the algorithm when implemented in a distributed-memory, coarse-grained parallel processing environment.

54036 (AD-A–209454/8/XAB) **Northeast Artificial Intelligence Consortium annual report, 1987. Volume 9. Computer architectures for very large knowledge bases. Interim report, December 1986-December 1987.** Berra, P.B. Syracuse Univ., NY (USA). Mar 1989. 216p. Available from NTIS, PC A10/MF A01.

See also Volume 1, AD-A209 395.

The Northeast Artificial Intelligence Consortium (NAIC) purpose is to conduct pertinent research in artificial intelligence and to perform activities ancillary to this research. This report describes progress that has been made. The topics covered in general are: versatile expert system for equipment maintenance, distributed AI for communications system control, automatic photo interpretation, time-oriented problem solving, speech-understanding systems, knowledge base maintenance, hardware architectures for very large systems, knowledge-based reasoning and planning, and a knowledge acquisition, assistance, and explanation system. The specific topic for this volume is the development of architectures for very large knowledge bases, especially in light of real time requests, parallelism, and the advent of optical computing.

54037 (AD-A–209606/3/XAB) **Multicast communication in multiprocessor systems.** Byrd, G.T.; Saraiya, N.P. Stanford Univ., CA (USA). Dept. of Computer Science. Jan 1989. 20p. (STAN-CS–89-1246). Available from NTIS, PC A03/MF A01.

Recent high-performance multiprocessors exploit cut-through routing, with packets routed as their first bytes arrive. Hardware-supported multicast can benefit the many parallel programs in which producers provide each value to multiple consumers. The authors describe several cut-through multicast protocols, including a restrictive (yet adaptive) routing scheme for deadlock avoidance. Simulations using synthetic and application-driven loads show it has significantly better performance than either multicast emulation or deadlock detection and resolution. The scheme provides cut-through multicast without requiring dedicated storage in the communication facilities for a full packet. The authors thus extend ideas considered for efficient cut-through routing in multiprocessor systems to include multicast.

54038 (ANL–87-26-Vol.4) **Proceedings of the focused research program on spectral theory and boundary value problems: Volume 4, Nonlinear differential equations.** Pieper, G.W. (ed.). Argonne National Lab., IL (USA). Aug 1989. 234p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. Order Number DE90000920. Available from NTIS, PC A11/MF A01 - OSTI; GPO Dep.

This report contains papers on the following topics: Self-Intersecting Solutions of the Prescribed Mean Curvature Equation; Bounds for Vertical Points of Solutions of Prescribed Mean Curvature Type Equations, I; Large Solutions of Elliptic Equations Involving Critical Exponents; Non-Negative Solutions for a Class of Radially Symmetric Non-Positone Problems; Quenching for Semilinear Singular Parabolic Problems; Existence Results of Steady States of Semilinear Reaction-Diffusion Equations and Their Applications; Uniqueness Results for Some Nonlinear Initial and Boundary Value Problems; Uniqueness of Non-Negative Solutions of a Class of Semilinear Elliptic Equations; A Non-Oscillation Theorem for the Emden-Fowler Equation; Ground States for Semilinear Elliptic Equations with Critical Exponents; Concavity and Monotonicity Properties of Solutions of Emden-Fowler Equations; Uniqueness for a Class of Non-Linear Initial Value Problems; Oscillation of Emden-Fowler Systems; and Local and Global Properties of Solutions of Quasilinear Elliptic Equations. These papers will be indexed separately.

54039 (ANL–89/12) **Research in mathematics and computer science at Argonne: January 1988–August 1989.** Pieper, G.W. Argonne National Lab., IL (USA). Aug 1989. 70p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. Order Number DE90000975. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This report reviews the research activities in the Mathematics and Computer Science Division at Argonne National Laboratory for the period January 1988 - August 1989. The body of the report gives a brief look at the MCS staff and the research facilities, and discusses various projects carried out in two major areas of research: analytical and numerical methods and advanced computing concepts. Projects funded by non-DOE sources are also discussed, and new technology transfer activities are described. Further information on division staff, visitors, workshops, and seminars is found in the appendices.

54040 (DOE/ER/25061–2) **A tensor product b-spline method for 3D multi-block elliptic grid generation.** Manke, J.W. Washington Univ., Seattle, WA (USA). Dept. of Applied Mathematics. Dec 1988. 24p. Sponsored by U.S. Department of Defense; U.S. DOE Energy Research. DOE Contract FG06-88ER25061. Order Number DE89017440. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We formulate a tensor product b-spline method for multi-block numerical grid generation. The Cartesian coordinate functions for a block are represented as a sum of tensor product b-spline basis functions defined on a parameter space for the block. The tensor product b-spline basis functions are constructed so that the basis functions and their first partials are continuous on the parameter space. The coordinate functions inherit this smoothness: a grid computed by evaluating the coordinate functions along constant parameter lines leads to smooth grid lines with smoothly varying tangents. The expansion coefficients for the coordinate functions are computed by solving the usual elliptic grid generation equations using simple collocation. This assures that the computed grid has the smoothness and resolution expected for an elliptic grid with appropriate control. An important result of the formulation is that the dimension of the collocation equations is the number of distinct knots for the tensor product b-spline basis functions. Combining this results with the smoothness of the b-spline representation makes it possible to reduce the dimension of the tensor product method with respect to the finite difference method, simply by using fewer knots than grid points. We formulate the expansion of the Cartesian coordinate functions as a sum of tensor product b-spline basis functions, and then we derive the collocation and boundary condition equations for the usual elliptic grid generation equations. We investigate the structure of the system of equations for the expansion coefficients and then formulate a solution algorithm to compute the coefficients. Finally, we describe the implementation of the method in a 2D multi-block grid code and discuss the performance of the method for several grids. 3 refs., 11 figs.

54041 (GA-A–19829) **ESnet/DECnet security policy, procedures and guidelines.** Caruso, D.T.; Bemis, C. Jr. General Atomics, San Diego, CA (USA). Sep 1989. 31p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-89ER53277;AC05-84OR21400. (CONF-8909213–1: ESNET/DECNET working group meeting, Stanford, CA (USA), 7-8 Sep 1989). Order Number DE90001009. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper presents a draft of a proposed ESnet-DECnet security manual identifying present and future DECnet security issues, including DECnet security guidelines.

54042 (INIS-mf–12006, pp. 44) **Electronics for online computers and data acquisition.** Nouvel, P.; Heck, U.; Menzer, R.; Thiel, P. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

Published in summary form only. DATA ACQUISITION SYSTEMS/electronic circuits; DEC COMPUTERS; IBM COMPUTERS; INTERACTIVE DISPLAY DEVICES; PLOTTERS; MAGNETIC DISKS; MAGNETIC TAPES; ANALOG-TO-DIGITAL CONVERTERS; CAMAC SYSTEM; TIME-TO-AMPLITUDE CONVERTERS; ON-LINE SYSTEMS; PERSONAL COMPUTERS

54043 (INIS-mf–12006, pp. 45) **Computer group.** Black, I.; Heusler, A.; Hoeptner, G.; Krafft, F.; Lang, R.; Moellenkamp, R.; Mueller, W.; Mueller, W.F.; Schmidt, A.; Schwind, D. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

The VAX-8650 has been running with no idle time during more than 98% of the time. Early in 1988 it became the boot member of a local area VAX cluster. Up to five satellites (mikroVAX II and VAXstation2000) joined the cluster building a pool of 22 disk drives. Experimences with the cluster system have shown a way to expand the capacity: Early in 1989, a second boot member (VAX3000) and several VAXstations (VAXstation2000 and VAXstation3200) will be added with additional disk space. (orig.).

54044 (INIS-mf–12006, pp. 45-46) **Development of a VAX-VMS multiparameter data acquisition system.** Kihm, T.; Knoepfle, K.T. Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.). 1989. (In German). In *Max-Planck-Institute for Nuclear Physics. Annual report 1988.* Order Number DE90711506. Available from NTIS (US Sales Only), PC A09/MF A01.

For multiparameter experiments an online data acquisition system was developed. Running on a VAX(VMS) computer it supports fast high resolution ADCs, histogramming memories and standard CAMAC modules. (orig.).

54045 (IPPJ-DT–149) **Examples of digital simulation of AC-DC power converter with the Electromagnetic Transients Program.** Tanahashi, Shugo; Yamada, Shuichi; Mugishima, Mituo; Kitagawa, Shiro. Nagoya Univ. (Japan). Inst. of Plasma Physics. Mar 1989. 52p. (In Japanese). Order Number DE90709992. Available from NTIS (US Sales Only), PC A04/MF A01.

This article gives a practical guidance for analysis of power converter circuits using the Electromagnetic Transients Program (EMTP). First how to use the program is shown with two simple examples; (1) a power supply with three-phase diode bridge and (2) a feedback system for current control. Then its application to more complicated system is shown with an example of a power supply for Compact Helical System (CHS), where a hybrid power supply with multi-phase diode and thyristor bridges, and two three-phase thyristor converters are driven by an AC generator. (author).

54046 (JAERI-M–89-068) **GRASYS: a computer program of graph synthesis system. User's manual.** Matsumoto, Kiyoshi; Kohsaka, Atsuo; Ohkubo, Shuji; Takigawa, Yoshio; Kobayashi, Hiroaki. Japan Atomic Energy Research Inst., Tokyo (Japan). May 1989. 158p. (In Japanese). Order Number DE90709991. Available from NTIS (US Sales Only), PC A08/MF A01.

A graphic synthesis system GRASYS has been developed. GRASYS has functions to create, registrate, reference and edit graphical data. On the GRASYS, a figure corresponds to a segment. The segment is a set of commands. A complex figure may be created by editing segments in a conventional mode. Time dependent graphs can also be handled as segments. Thus the user can represent the status of nuclear power plant in case of an accident. GRASYS is made as a general graph handler so that it may be used for other application. GRASYS has a sub-system, GREDIT. GREDIT has functions to handle segments on the CRT screen to create a new figure and to output a command file correspondent to the new figure on the screen. This report is a user's manual of GRASYS including GREDIT. (author).

54047 (JINR-D–17-88-95) **4. International symposium on selected topics in statistical mechanics.** Joint Inst. for Nuclear Research, Dubna (USSR). 1988. 200p. (In Russian). (CONF-8708341–: 4. international symposium on selected topics in statistical mechanics, Dubna (USSR), 25-29 Aug 1987). Order Number DE90705928. Available from NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS.

Individual papers in scope for the data base are processed separately.

54048 (K/CSD/TM–64/Rev.3) **Automated Estimating System (AES): Version 3.1, User's manual: Revision 3.** Holder, D.A. Oak Ridge Gaseous Diffusion Plant, TN (USA). Sep 1989. 87p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OT21400. Order Number DE90001869. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

This document describes Version 3.1 of the Automated Estimating System, a personal computer-based software package designed to aid in the creation, updating, and reporting of project cost estimates for the Estimating and Scheduling Department of the Martin Marietta Energy Systems Engineering Division. Version 3.1 of the Automated Estimating System is capable of running in a multiuser environment across a token ring network. The token ring network makes possible services and applications that will more fully integrate all aspects of information processing, provides a central area for large data bases to reside, and allows access to the data base by multiple users. Version 3.1 of the Automated Estimating System also has been enhanced to include an Assembly pricing data base that may be used to retrieve cost data into an estimate. A WBS Title File program has also been included in Version 3.1. The WBS Title File program allows for the creation of a WBS title file that has been integrated with the Automated Estimating System to provide WBS titles in update mode and in reports. This provides for consistency in WBS titles and provides the capability to display WBS titles on reports generated at a higher WBS level.

54049 (LA-UR–89-527) **Risk assessment and LAVA's [Los Alamos Vulnerability and Risk Assessment] dynamic threat analysis.** Smith, S.T. Los Alamos National Lab., NM (USA). 1989. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-891064–2: 12. national computer security conference, Baltimore, MD (USA), 10-13 Oct 1989). Order Number DE89007990. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

LAVA (the Los Alamos Vulnerability/Risk Assessment system) is a three-part systematic approach to risk assessment that can be used to model risk assessment for a variety of application systems such as computer security systems, communications security systems, and information security systems. The first part of LAVA is the mathematical methodology based on such disciplines as hierarchical system theory, event-tree analysis, possibility theory, and cognitive science. The second part is the general software engine,written for a large class of personal computers, that implements the mathematical risk model. The third part is the application data sets written for a specific application system. The methodology provides a framework for creating applications for the software engine to operate upon; all application-specific information is data. Using LAVA, we build knowledge-based expert systems to assess risks in application systems comprising a subject system and a safeguards system. The subject system model comprises sets of threats, assets, and undesirable outcomes; because the threat to security systems is ever-changing, LAVA provides for an analysis of the dynamic aspects of the threat spectrum. The safeguards system model comprises sets of safeguards functions for protecting the assess from the threats by preventing or ameliorating the undesirable outcomes; sets of safeguards subfunctions whose performance determine whether the function is adequate and complete; and sets of issues that appear as interactive questionnaires, whose measures define both the weaknesses in the safeguards system and the potential costs of an undesirable outcome occurring. 29 refs.

54050 (LA-UR–89-1627) **Multiple crossbar network: Integrated supercomputing framework.** Hoebelheinrich, R. Los Alamos National Lab., NM (USA). [1989]. 17p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-891149–2: Supercomputing '89 conference, Reno, NV (USA), 13-17 Nov 1989). Order Number DE89012614. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

At Los Alamos National Laboratory, site of one of the world's most powerful scientific supercomputing facilities, a prototype network for an environment that links supercomputers and workstations

is being developed. Driven by a need to provide graphics data at movie rates across a network from a Cray supercomputer to a Sun scientific workstation, the network is called the Multiple Crossbar Network (MCN). It is intended to be coarsely grained, loosely coupled, general-purpose interconnection network that will vastly increase the speed at which supercomputers communicate with each other in large networks. The components of the network are described, as well as work done in collaboration with vendors who are interested in providing commercial products. 9 refs.

54051 (LA-UR–89-1829) **Software tools for controlling, distributing, and installing software at Los Alamos National Laboratory.** Pfaff, R.; Sanders, C.; Cohen, M. Los Alamos National Lab., NM (USA). [1989]. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-891149–1: Supercomputing '89 conference, Reno, NV (USA), 13-17 Nov 1989). Order Number DE89012633. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper focuses on software tools Los Alamos National Laboratory (LANL) uses to control, distribute, and install user level software, such as language, libraries, and utilities. LANL's computing network is complex enough to represent many, if not all of the problem seen at other sites. The network keeps a system of multi-leveled security partitions separate, while integrating Cray supercomputers with both CTSS and UNICOS operating systems as well as many other types of machines such as VAXes with VMS, SUNs, and Apollos. Change control is the process by which the distribution and installation of new or changes software is controlled. Software tools have been and are being incorporated into the change control procedures to improve efficiency, reliability, and security. Tools for general management are designed to be accused from any type of computer, while tools for installing files on specific operating systems are designed to be independent. One of the new independent tools is a software package for distributing and installing UNIX™ software. This package, called CCMAKE, could be used as a basis for standardizing a way to assure that all needed files and information are included in a distribution as well as a way to install normal applications, utilities, and libraries. It therefore has the potential to benefit exchanging software between UNIX sites. 1 ref.

54052 (LA-UR–89-2974) **An efficient UNICOS run-time system for functional programs on a CRAY X-MP.** Hammes, J.P.; Yantis, B.; Michelsen, R.; Fasel, J.H. III; Fasel, P.K. Los Alamos National Lab., NM (USA). [1989]. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-891149–4: Supercomputing '89 conference, Reno, NV (USA), 13-17 Nov 1989). Order Number DE89016603. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The ParaGraph (Parallel Graph reduction) project at Los Alamos National Laboratory is an investigation of the use of functional languages for scientific applications; efficient implementation strategies are a primary concern. The initial version of the ParaGraph run-time system, ParaGraph-RTS 1.0, was not targeted for the X-MP architecture specifically. We examine the new Cray X-MP UNICOS single processor implementation, ParaGraph-RTS 2.0, and describe the CRAY specific optimizations employed. Optimizations include novel use of the CRAY X-MP register set and the generation of optimized assembly code. Performance improvements over ParaGraph-RTS 1.0 have been significant; initial measurements are presented. 8 refs., 4 figs.

54053 (LBL–27696) **Versatility of the CFR [Constrained Fourier Reconstruction] algorithm for limited angle reconstruction.** Fujieda, I.; Heiskanen, K.; Perez-Mendez, V. Lawrence Berkeley Lab., CA (USA). Aug 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-891087–2: IEEE nuclear science symposium and exhibits, San Francisco, CA (USA), 25-27 Oct 1989). Order Number DE90001421. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Constrained Fourier Reconstruction (CFR) algorithm and the Iterative Reconstruction-Reprojection (IRR) algorithm are evaluated based on their accuracy for three types of limited angle reconstruction problems. The CFR algorithm performs better for problems such as Xray CT imaging of a nuclear reactor core with one large data gap due to structural blocking of the source and detector pair. For gated heart imaging by Xray CT, radioisotope distribution imaging by PET or SPECT, using a polygonal array of gamma cameras with insensitive gaps between camera boundaries, the IRR algorithm has a slight advantage over the CFR algorithm but the difference is not significant. 3 refs., 5 figs.

54054 (N–89-24058) **Compiling high level constructs to distributed memory architectures. Final report.** Mehrotra, P.; Vanrosendale, J. National Aeronautics and Space Administration, Hampton, VA (USA). Inst. for Computer Applications in Science and Engineering. Mar 1989. 12p. (NASA-CR–181825;NAS–1.26:181825;ICASE–89-20). Available from NTIS, PC A03/MF A01.

Current languages for nonshared memory architectures provide a relative low-level programming environment. A set of primitives such as load balance and data distribution, which allow the programmer to express data-parallel algorithms at a higher level while also permitting control over those aspects of the program critical to performance, are described. Given such a program specification, the compiler automatically generates a distributed program containing send and receive constructs to perform interprocess communication.

54055 (ORNL/TM–11140) **A framework for studying genetic optiization of complex systems.** Liepins, G.E. Oak Ridge National Lab., TN (USA). Sep 1989. 39p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90001848. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Although functions of interest are generally defined either on some subset of the Cartesian product of the reals or some discrete set, genetic optimization only directly addresses functions defined on diadic groups. As a result the success of genetic optimization relative to the original domain is often dependent on the chosen embedding and representation. This paper analyzes "ga hard and ga easy" functions, provides a constructive procedure (that does not use Walsh transforms) to generate hard problems, proves that no single representation is optimal for all functions, and introduces two classes of transformations to change selected hard functions into easy ones. Two procedures for representational change are suggested. 45 refs., 1 fig., 8 tabs.

54056 (ORNL/TM–11315) **Nonlinear maps with competitive interactions: Fixed-points, bifurcations, and chaotic attractors.** Scollan, D.F.; Azmy, Y.Y.; Protopopescu, V. Oak Ridge National Lab., TN (USA). Sep 1989. 70p. Sponsored by U.S. Department of Defense; U.S. DOE Defense Programs. DOE Contract AC05-84OR21400. Order Number DE90001858. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

We examine several aspects of the dynamical behavior of competitive systems modeled by nonlinear maps. We analytically investigate some features of special cases of such maps, and we use the symbolic manipulator MACSYMA to derive expressions for the linearized systems' eigenvalues. These enable us to determine the linear stability of some of the fixed and periodic points of these maps, and in some cases, yield the regions of attraction in phase space. We extend the analysis to a more general form of competitive systems. The two-species one-index system and the one-species two-index map are numerically explored in search for interesting bifurcation and/or chaotic regimes over a large range of parameters. We will show that system with linear attrition displays stable, interesting behavior for a large region of parameter space even if the quadratic self-repression is taken very small. We will also show that small quadratic self-repression combined with bilinear attrition generally results in steady-state solutions with one species zero or in unbounded iterates. We describe the method used to obtain an approximate estimate of the correlation dimensions of the chaotic attractor. We also propose a new method to evaluate the correlation dimension of a chaotic attractor using statistical analysis methods. 19 refs., 31 figs., 9 tabs.

54057 (PB–89-205249/XAB) **Design and implementation of parallel MAKE.** Baalbergen, E.H. Vrije Univ., Amsterdam (Netherlands). Subfaculteit Wiskunde en Informatica. Dec 1987. 18p. (IR–141). Available from NTIS, PC EE03/MF A01.

MAKE is the standard UNIX utility for maintaining programs. UNIX programmers have been using it for almost 10 years, and

many UNIX programs nowadays are maintained by it. The strength of MAKE is that it allows the user to specify how to compile program components, and that the system, after an update, is regenerated according to the specification and with minimum number of recompilations. With the appearance of multiple-processor systems, the time needed to 'make' a program, or target, can effectively be reduced. Although the hardware provides parallelism, few tools are able to exploit the parallelism. The introduction of parallelism to MAKE is the subject of the paper. A parallel MAKE is described and an analysis of its performance is given.

54058 (PB–89-216477/XAB) **Architecturally-focused benchmarks with a communication example.** Lyon, G.E.; Snelick, R.D. National Inst. of Standards and Technology (NCSL), Gaithersburg, MD (USA). Advanced Systems Div. Mar 1989. 39p. (NISTIR–89/4053). Available from NTIS, PC A03/MF A01.

The discussion first sketches a framework of modalities for an architecturally-focused performance evaluation. The result is a hybrid of benchmarking and modeling: elements of capacity-and-use trees (CUTs) are explored as a simplified notation. There follows a description of the structure and preliminary results from a practical benchmark set for process communication. Argument is given that performance within a class of architecture is often dominated by unavoidable competitions within distinct machine modalities, such as scalar-vector. A k-alternative, forced choice defines a dimension of comparison equally well in SI- or MIMD architectures. Performance estimators are interpolations between values from basis benchmarks for modes; ideally, in the two-alternative forced choice only two benchmark measurements are needed. Refinements in basis benchmarks support CUT-based estimates of performance.

54059 (PNL-SA–17406) **The components of scientific visualization.** Desmarais, T.D. Pacific Northwest Lab., Richland, WA (USA). Oct 1989. 6p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-8910103–2: Supercomputing conference, San Francisco, CA (USA), 16-20 Oct 1989). Order Number DE90001992. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The purpose of scientific visualization is to improve the ability of a human to analyze and understand data. A goal of visualization is improving productivity. If we measure the success of our visualization by measuring only the increase in productivity, we are missing a key capability of proper visualization: the improvement in our ability to discover through exploration. This paper presents a breakdown of the components that improve the success of visualization as measured in both productivity and discovery. Important concepts associated with these components are described in order to give the supercomputer user practical guidelines during construction of a visualization system. 4 refs., 1 fig.

54060 (SAND–88-2416) **Network architecture functional description and design: Version 2.0.** Stans, L.; Bencoe, M.; Brown, D.; Kelly, S.; Pierson, L.; Schaldach, C. Sandia National Labs., Albuquerque, NM (USA). 25 May 1989. 82p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE90001865. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This report provides a top level functional description and design for the development and implementation of the central network to support the next generation of SNL, Albuquerque supercomputer in a UNIX® environment. It describes the network functions and provides an architecture and topology.

54061 (SAND–89-2288C) **How good is the Acme Code.** Simmons, G.J. Sandia National Labs., Albuquerque, NM (USA). 1989. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8908103–2: 4. joint Swedish/Soviet international workshop on information theory, Gutland (Sweden), 27 Aug - 1 sep 1989). Order Number DE90000809. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Contrary to the widely held belief that error detecting and correcting codes originated at the Bell Telephone Laboratories in the late 40's with the work of C.E. Shannon and R.W. Hamming, the Acme Commercial Code which was devised by A.C. Meisenbach in 1923 is a bona fide example of an error detecting and correcting code. In fact, Meisenbach went to considerable trouble to design his code so that there would be an efficient error correction scheme (decoder). To the authors knowledge, this is the earliest example of an error detecting and correcting code. Since the Acme code is virtually unknown today, a brief description of its intent and construction are needed in order to appreciate the title question. 4 refs.

54062 (UCRL–101911) **High performance parallel architectures.** Anderson, R.E. Lawrence Livermore National Lab., CA (USA). Sep 1989. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-891149–7: Supercomputing '89 conference, Reno, NV (USA), 13-17 Nov 1989). Order Number DE90001055. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In this paper the author describes current high performance parallel computer architectures. A taxonomy is presented to show computer architecture from the user programmer's point-of-view. The effects of the taxonomy upon the programming model are described. Some current architectures are described with respect to the taxonomy. Finally, some predictions about future systems are presented. 5 refs., 1 fig.

54063 (WSRC-RP–89-451) **Implementation of outline software for priority management.** Miller, P.E. Westinghouse Savannah River Co., Aiken, SC (USA). 1989. 20p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-891192–1: Annual Westinghouse computer symposium, Pittsburgh, PA (USA), 6-7 Nov 1989). Order Number DE89017866. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

No matter what your profession, most busy days require that you juggle priorities – especially when an unexpected occurrence changes your plans. In spite of such priority juggling, relatively few people use computers to help them to decide on which job to do next. Such lack of this computer application is of no surprise. Consider that the human brain has a 100 billion-cell capacity. Each neuron of the brain is capable of receiving 100,000 or more signals. It is easy to understand, then, why such a powerful organizing and memory system is so apt with notebook, yellow stickies, or pad and pencil. But if you are responsible for the status or progress of as many as 25 to 200 or more jobs on a given day, then a computer with outliner software could be one of your most useful tools. Some trees in the work-jungle change overnight. Outliner software can help you to keep track of such changes that beget changes, seemingly without end. 14 figs.

54064 (WSRC-RP–89-461) **Personal computer process data acquisition.** Dworjanyn, L.O. Westinghouse Savannah River Co., Aiken, SC (USA). 1989. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-891192–6: Annual Westinghouse computer symposium, Pittsburgh, PA (USA), 6-7 Nov 1989). Order Number DE89017877. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A simple Basic program was written to permit personal computer data collection of process temperatures, pressures, flows, and inline analyzer outputs for a batch-type, unit operation. The field voltage outputs were read on a IEEE programmable digital multimeter using a programmable scanner to select different output lines. The data were stored in ASCII format to allow direct analysis by spreadsheet programs. 1 fig., 1 tab.

54065 (WSRC-RP–89-516) **HyperCard development and implementation at SRS [Savannah River Site].** Young, M. Westinghouse Savannah River Co., Aiken, SC (USA). 1989. 13p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-891192–3: Annual Westinghouse computer symposium, Pittsburgh, PA (USA), 6-7 Nov 1989). Order Number DE89017868. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

HyperCard running on Apple Macintosh computers is being used in many different ways at WSRC. We currently have applications running within HyperCard that act as an expert system for new Macintosh users, we have a version of our card catalog for the 20,000 + volume technical library, as a personnel locator for our 14,000 + employee record file and as reference material for technical writers. We use HyperCard as a front end to our QA procedures and for a back end to our data acquisition systems. We often use HyperCard

as a vehicle to move data from one computer platform to another because of its comprehensive file manipulation capabilities. 8 figs.

54066 Designing arrays for modern high-resolution methods. Ballance, W.P. (Lawrence Livermore National Lab., Livermore, CA (US)); Jaffer, A.G. pp. 994 of Proceedings of the twenty-first Asilomar conference on signals, systems and computers. Chen, R.R. IEEE Service Center, Piscataway, NJ (1988). (CONF-871162–: 21. annual Asilomar conference on signals, systems, and computers, Pacific Grove, CA (USA), 2-4 Nov 1987).

A bearing estimation study of seismic wavefields propagating from a strongly heterogeneous media show that with the high-resolution MUSIC algorithm the bias of the direction estimate can be reduced by adopting a smaller aperture sub-array. Further, on this sub-array, the bias of the MUSIC algorithm is less than those of the MLM and Bartlett methods. On the full array, the performance for the three different methods are comparable. Improvement in bearing estimation in MUSIC with a reduced aperture might be attributed to increased signal coherency in the array. For methods with less resolution, the improved signal coherency in the smaller array is possibly being offset by severe loss of resolution and the presence of weak secondary sources. Building upon the characteristics of real seismic wavefields, a design language has been developed to generate, modify, and test other arrays. Eigenstructures of wavefields and arrays have been studied empirically by simulation of a variety of realistic signals.

54067 Executable assertion development for the distributed parallel environment. McMillin, B.M. (Univ. of Missouri-Rolla, Rolla, MO (US)); Ni, L.M. pp. 527 of Proceedings of COMPSAC 88: The twelfth annual international computer software and applications conference. IEEE Service Center, Piscataway, NJ (1988). (CONF-8810254–: COMPSAC '88: 12th annual international computer software and applications conference, Chicago, IL (USA), 5-7 Oct 1988).

The use of executable assertions is a powerful tool with which to perform program verification, to provide software fault-tolerance, and to provide hardware fault-tolerance via the application-oriented paradigm. In this paper the authors show that assertions commonly usd in the sequential programming environment are inadequate for the distributed parallel environment. In particular it is shown that even design based assertions are myopic and provide inadequate error coverage. In their place, a triad of basis metrics are proposed for certain classes of problems which, when applied beginning with the specification phase of the life cycle, produce assertions that are better suited to the parallel environment. This method is applied to a well-known parallel computing problem in order to demonstrate the effectiveness of the method.

54068 Calculation and visualization of turbulent flows on the Cedar multiprocessor supercomputer. Roloff, R. (Center for Supercomputing Research and Development, and Dept. of Mechanical and Industrial Engineering, UIUC, Urbana, IL (US)). pp. 1021 of Proceedings of the 1987 summer computer simulation conference. Chou, J.Q.B Society for Computer Simulation, San Diego, CA (1987). (CONF-870706–: 19. annual summer computer simulation conference, Montreal (Canada), 27-30 Jul 1987).

Turbulent flow is unsteady, chaotic, and three dimensional. The Navier-Stokes equations are generally regarded as an appropriate mathematical model; however there are no known analytic solutions for turbulent flows. A recent calculation for a model problem with simple geometry required 28 million words and 250 cpu hours on a Cray-XMP. The Cedar supercomputer project is an attempt to develop shared memory technology for multiprocessor scientific computing. Current plans envision a 32 processor machine, with computational power equivalent to a single processor Cray XMP, by the end of the year. Cedar consists of four Alliant FX/8 computers connected via a network that provides instruction synchronization and global memory access. Software that was not developed for execution on multiprocessor machines usually needs to be modified to achieve high parallel efficiency. The ability to achieve a factor of N speedup with N processors is critical. It is shown in this paper that most of the fluid mechanics algorithms in use today can be organized to achieve high parallel efficiency. Determinating the correctness of a fluid dynamics calculation requires visualization of the flow field. Sophisticated graphics capability is needed to plot the complex structures that evolve during transition from laminar flow to fully developed turbulence.

54069 INSPECTR. Kessler, T. (Expert-EASE Systems, Inc., Belmont, CA (US)); Liu, G.; Frogner, B.; Gloski, D.; Wallace, P.; Shieh, D.R. pp. 910 of Artificial intelligence and other innovative computer applications in the nuclear industry. Majumdar, M.C.; Majumdar, D.; Sackett, J.I American Nuclear Society, La Grange Park, IL (1987). (CONF-870832–: Topical meeting on artificial intelligence and other innovative computer applications in the nuclear industry: present and future, Snowbird, UT (USA), 31 Aug - 2 sep 1987).

The ability to diagnose and correct chronic performance problems at the site without waiting for expert assistance to be made available represents a significant benefit to any power plant. The INSPECTR Interactive Performance Diagnostic Assistant incorporates the latest advances in Artificial Intelligence technology (e.g. model-based reasoning and evidential reasoning with uncertainty) to address the problem of on-site diagnosis of performance problems. As a PC-based performance diagnostic expert system, INSPECTR provides a practical means of combining the analytical expertise of an experienced corporate office engineering staff with the hands-on expertise of a site-based performance engineer. Working together, INSPECTR and the performance engineer can identify, diagnose and correct performance problems that would otherwise require a significant allocation of corporate staff and/or outside consultant resources.

54070 ANS-10 standards - current status and future direction. Poetschat, G.R. *Transactions of the American Nuclear Society (USA),* 56: 266 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

The ANS-10 Standards Subcommittee is sponsored by the Mathematics and Computation Division of the American Nuclear Society (ANS). The scope of ANS-10 activities includes the development of standards that will promote effective utilization of and enhance the reliability of computer programs throughout the nuclear community. The application of ANS-10 standards during the computer program development process creates coding and documentation for the program product that promotes effective use and enhances reliability. The end product is a program package that contains adequate documentation, includes verification and validation results, is easy to use and maintain, and is easy to transfer from one hardware-software system to another.

54071 EXAP - precompiler for the GRESS and ADGEN automated sensitivity calculation systems. Horwedel, J.E.; Pin, F.G.; Worley, B.A. *Transactions of the American Nuclear Society (USA),* 56: 301-302 (1988). (CONF-880601–: American Nuclear Society annual meeting, San Diego, CA (USA), 12-16 Jun 1988).

In recent years, two automated systems have been developed that add derivative taking capability to existing FORTRAN codes. The derivative information is used to calculate sensitivities of model results to input data. The two systems, GRESS and ADGEN, solve the forward and adjoint sensitivity problems, respectively. Both systems are based on a precompiler that automates the calculation of derivatives of the real variable on the left-hand-side (LHS) of each equation with respect to the real variables on the right-hand-side (RHS) of each equation. This paper describes the features of the extended arithmetic processor (EXAP) precompiler that makes the automation of differentiation capability practical.

9903 Information Handling

Refer also to citation(s) 52291, 52292, 52322, 52498, 53113, 53438, 54029, 54057, 54058

54072 (ETDE-IT–89-10) **Towards the intelligent plant.** D'Ambrosio, A.; Serventi, A. Ansaldo S.p.A., Genoa (Italy). Nov 1987. 8p. (CONF-8711245–8: Workshop on computers applications for nuclear powers and industrial process plant operation and control, Rome (Italy), 19-20 Nov 1987). Order Number DE89793126. Available from NTIS (US Sales Only), PC A02.

The application of Knowledge Based Systems (KBS) in nuclear power and industrial plants is currently under development at ANSALDO (Italy) Eng. R&D in collaboration with APEIRON, consulting in Expert System (ES) design and development. A most important objective is to get from the stage of stand-alone systems

to their integration within industrial plants. The integration of ES's is engineered to make the resulting system able to deal with different tasks (diagnosis, control, planning, etc.). Methodologies and tools for ES integration must be so developed to be general with respect to different application domains; this will bring a decrease in engineering costs thereby making the technology competitive and evermore popular.

54073 (INIS-BR–1664) **Scientific and technical production of Ipen - 1988.** Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Div. de Informacao e Documentacao Cientificas. 1989. 61p. (In Portuguese). Order Number DE90606936. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

This bulletin shows the papers done by the Ipen's researches during the 1988. In the appendix, the papers published since 1985 to 1987 are presented. The references are grouped by publications types. (author).

54074 (N–89-23528, pp. 161-175) **EnviroNET: Space environment for Strategic Defense Initiative experiments.** Lauriente, M. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. May 1989. (NASA-CP–3035-PT-1;L–16575-PT-1;NAS–1.55:3035-PT-1;CONF-8806434–: NASA/SDIO space environmental effects on materials workshop, Hampton, VA (USA), 28 Jun - 1 jul 1988). In *NASA/SDIO Space Environmental Effects on Materials Workshop, part 1.* Available from NTIS, PC A16/MF A01.

EnviroNET is an operational system available to the Strategic Defense Initiative (SDI) experimenters who have access to a terminal or dial-up port. It is a tail node on Space Physics Analysis Network (SPAN) accessible directly or through the national networks via NPSS. Some of the benefits to using EnviroNET include: validated NASA environmental information and interactive space models; facilitating the payload integration process; easy access to expert assistance; and potential for time and cost savings.

54075 (PB–89-868400/XAB) **Supervisory control and data acquisition (SCADA). January 1977-July 1989 (Citations from the INSPEC: Information Services for the Physics and Engineering Communities database). Report for January 1977-July 1989.** National Technical Information Service, Springfield, VA (USA). Aug 1989. 95p. Available from NTISPC N01/MF N01.

Supersedes PB–87-852893.

This bibliography contains citations concerning the design, standards and implementation, and performance evaluations of supervisory control and data acquisition (SCADA) systems for industrial control and monitoring processes. Topics include distributed process control, batch processing, load-management systems, centralized control, fault isolation, and real-time control. Applications in manufacturing, electric-utility distribution networks, domestic water supply remote monitoring, oil and natural gas pipeline distribution and fault isolation, and telecommunication networks are presented. (This updated bibliography contains 207 citations, 112 of which are new entries to the previous edition.)

54076 (WSRC-RP–89-467) **Training Management Information System.** Rackley, M.P. Westinghouse Savannah River Co., Aiken, SC (USA). [1989]. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-891192–4: Annual Westinghouse computer symposium, Pittsburgh, PA (USA), 6-7 Nov 1989). Order Number DE89017870. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Training Management Information System (TMIS) is an integrated information system for all training related activities. TMIS is at the leading edge of training information systems used in the nuclear industry. The database contains all the necessary records to confirm the department's adherence to accreditation criteria and houses all test questions, student records and information needed to evaluate the training process. The key to the TMIS system is that the impact of any change (i.e., procedure change, new equipment, safety incident in the commercial nuclear industry, etc.) can be tracked throughout the training process. This ensures the best training can be performed that meets the needs of the employees. TMIS is comprised of six functional areas: Job and Task Analysis, Training Materials Design and Development, Exam Management, Student Records/Scheduling, Evaluation, and Commitment Tracking. The system consists of a VAX 6320 Cluster with IBM and MacIntosh computers tied into an ethernet with the VAX. Other peripherals are also tied into the system: Exam Generation Stations to include mark sense readers for test grading, Production PC's for Desk-Top Publishing of Training Material, and PC Image Workstations. 5 figs.

54077 (WSRC-RP–89-472) **Procurement of an optical disk information storage and retrieval system.** Hudson, B.J. Westinghouse Savannah River Co., Aiken, SC (USA). [1989]. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-891192–16: Annual Westinghouse computer symposium, Pittsburgh, PA (USA), 6-7 Nov 1989). Order Number DE90001372. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

There are a number of factors that affect the decision to buy an optical disk based system for records management or information retrieval. Systems that are currently offered may be aimed at certain markets or specialized needs. The prospective buyer of an image storage system must perform a thorough requirements analysis to determine his needs. This presentation will discuss the following issues and their impact on the system requirements: Volume of records; Scanning workloads; Photographs/halftones; Standalone vs network; Use of existing index systems; Growth paths, integration to network; Legal, DOE considerations; Who are your users; Types of records; Retrieval workloads; Oversize documents; Use of existing workstations; Image quality vs file sizes; Proprietary vs standard components; Records vs information; and What is your justification. 1 fig.

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Refer also to citation(s) 52853

54078 (AD-A–209447/2/XAB) **SDS (strategic defense system) software testing and evaluation: A review of the state-of-the-art in software testing and evaluation with recommended R & D (research and development) tasks. Final report.** Youngblut, C.; Brykczynski, B.R.; Salasin, J.; Gordon, K.D.; Meeson, R.N. Institute for Defense Analyses, Alexandria, VA (USA). Feb 1989. 166p. (IDA-P–2132). Available from NTIS, PC A08/MF A01.

This document identifies the technology required for effective and efficient testing and evaluation of Strategic Defense System (SDS) software. This document provides an overview of current testing and evaluation technology, a mapping of available technology against SDS needs, and recommendations to close critical gaps in technology.

54079 (N–89-24443) **Summary and evaluation of the Strategic Defense Initiative space power architecture study.** Edenburn, M.; Smith, J.M. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Mar 1989. 418p. (NASA-TM–102012;E–4724;NAS–1.15:102012). Available from NTIS, PC A18/MF A01.

The Space Power Architecture Study (SPAS) identified and evaluated power subsystem options for multimegawatt electric (MMWE) space based weapons and surveillance platforms for the Strategic Defense Initiative (SDI) applications. Steady state requirements of less than 1 MMWE are adequately covered by the SP-100 nuclear space power program and hence were not addressed in the SPAS. Four steady state power systems less than 1 MMWE were investigated with little difference between them on a mass basis. The majority of the burst power systems utilized H(2) from the weapons and were either closed (no effluent), open (effluent release) or steady state with storage (no effluent). Closed systems used nuclear or combustion heat source with thermionic, Rankine, turboalternator, fuel cell and battery conversion devices. Open systems included nuclear or combustion heat sources using turboalternator, magnetohydrodynamic, fuel cell or battery power conversion devices. The steady state systems with storage used the SP-100 or Star-M reactors as energy sources and flywheels, fuel cells or batteries to store energy for burst applications. As with other studies the open systems are by far the lightest, most compact and simplist (most reliable) systems. However, unlike other studies the SPAS studied potential platform operational problems caused by effluents or vibration.

Corporate Author Index

This index lists the corporate authors responsible for issuing the documents in this publication which are identified primarily by report number. The corporate names are entered in standardized forms as defined in *DOE Energy Data Base: Corporate Author Entries* (DOE/TIC-4585). Each entry under a corporate name includes the document title and citation number. Three items of information may appear in parentheses: (1) an abbreviation to identify the document type, such as a report; (2) the country of publication, also abbreviated; and (3) the language of the document if non-English (R;US;In French). Author affiliations are not listed in this index.

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	Westinghouse Hanford Co., Shippingport, PA (USA). Shippingport Station Decommissioning Project Office	
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AC07-76ID01570	**EG and G Idaho, Inc., Idaho Falls, ID (USA)**	
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AC07-88ID12701	**Wisconsin Univ., Madison, WI (USA)**	
	14:52477	DOE/ID/12701–1
AC08-87NV10576	**Science Applications International Corp., Las Vegas, NV (USA)**	
	14:51755	CONF-891101–1
AC08-89NV10630	**Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)**	
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AC09-76SR00001	**Savannah River Lab., Aiken, SC (USA)**	
	14:52276	DP–1766-Rev.1
AC09-89SR18035	**Savannah River Lab., Aiken, SC (USA)**	
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AC21-85MC21353	**EG and G Washington Analytical Services Center, Inc., Morgantown, WV (USA)**	
	14:51734	DOE/MC/21353–2669
AC21-86MC23075	**Advanced Fuel Research, Inc., East Hartford, CT (USA)**	
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AC21-87MC23288	**City Coll., New York, NY (USA)**	
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AC22-87PC79936	SRI International, Menlo Park, CA (USA)	
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AC22-88PC88810	National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)	
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AC22-88PC88818	Hydrocarbon Research, Inc., Lawrenceville, NJ (USA)	
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AC22-88PC88827	Pennsylvania State Univ., University Park, PA (USA). Coll. of Earth and Mineral Sciences	
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AC22-88PC88867	Southern Research Inst., Birmingham, AL (USA)	
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AC22-88PC88868	Southern Research Inst., Birmingham, AL (USA)	
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AC22-88PC88878	Columbia Univ., New York, NY (USA)	
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AC22-88PC88949	Westinghouse Electric Corp., Pittsburgh, PA (USA). Science and Technology Center	
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AC22-88PC88951	Institute of Gas Technology, Chicago, IL (USA)	
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AI01-87ER13668	National Inst. of Standards and Technology, Boulder, CO (USA). Thermophysics Div.	
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AI79-84BP16380	USDOE Bonneville Power Administration, Portland, OR (USA)	
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FC22-83FE60149	National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)	
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FG01-86CE15270	Missouri Univ., Columbia, MO (USA). School of Forestry, Fisheries and Wildlife	
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FG02-84ER45102	Purdue Univ., Lafayette, IN (USA). Dept. of Chemistry	
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FG02-86ER13476	Pennsylvania Univ., Philadelphia, PA (USA). Dept. of Biochemistry and Biophysics	
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FG02-86ER40269	Colorado Univ., Boulder, CO (USA)	
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FG02-86ER52127	Illinois Univ., Urbana, IL (USA). Fusion Studies Lab.	
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FG03-86ER52130	California Univ., Los Angeles, CA (USA). Inst. of Plasma and Fusion Research	
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FG03-86ER52134	California Univ., Los Angeles, CA (USA). Inst. of Plasma and Fusion Research	
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FG05-87ER13678	Oklahoma Univ., Norman, OK (USA)	
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FG05-87ER40330	Georgia Inst. of Tech., Atlanta, GA (USA). School of Physics	
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FG05-87ER40343	Texas Univ., Austin, TX (USA). Dept. of Physics	
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FG05-88ER40418	Maryland Univ., College Park, MD (USA). Dept. of Chemistry and Biochemistry	
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FG22-88PC88924	Western Kentucky Univ., Bowling Green, KY (USA). Center for Coal Science	
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209415/9/XAB	14:52946	NTIS, PC A02/MF A01			
209425/8/XAB	14:52638	NTIS, PC A03/MF A01			
209426/6/XAB	14:53137	NTIS, PC A03/MF A01			
209430/8/XAB	14:52947	NTIS, PC A02/MF A01			
209433/2/XAB	14:51876	NTIS, PC A02/MF A01			
209443/1/XAB	14:54035	NTIS, PC A02/MF A01			
209447/2/XAB	14:54078	NTIS, PC A08/MF A01			
209454/8/XAB	14:54036	NTIS, PC A10/MF A01			
209466/2/XAB	14:53635	NTIS, PC A03/MF A01			
209469/6/XAB	14:53657	NTIS, PC A99/MF E06			
209499/3/XAB	14:52424	NTIS, PC A03/MF A01			
209500/8/XAB	14:52501	NTIS, PC A03/MF A01			
209522/2/XAB	14:53636	NTIS, PC A02/MF A01			
209542/0/XAB	14:53623	NTIS, PC A03/MF A01			
209572/7/XAB	14:52031	NTIS, PC A05/MF A01			
209589/1/XAB	14:53545	NTIS, PC A04/MF A01			
209606/3/XAB	14:54037	NTIS, PC A03/MF A01			
AECL–					
7272	14:53427	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE90606459	
AERE-R–					
12961	14:51752	H.M. Stationery Office, London, price Pound 10.00			
13393	14:53274	H.M. Stationery Office, London, price Pound 10.00			
13417	14:52922	H.M. Stationery Office, London, price Pound 8.00			
AFIT/GNE/ENP–					
89M-7	14:53315	*See* AD-A–209225/2/XAB			
AFWL-TR–					
88-50-REV	14:52891	*See* AD-A–208643/7/XAB			
AIAA–					
89-2302	14:52030	*See* N–89-24445			
AID-EVALUATION-SS–					
60	14:52386	*See* PB–89-202832/XAB			
AMTI–					
2236-1	14:53105	*See* AD-A–209356/5/XAB			
ANL–					
87-26-Vol.4	14:54038	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000920	PC-405
89/12	14:54039	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000975	PC-405
89/14	14:51753	NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000916	PC-504; PC-510
ANL/FPP/TM–					
240	14:53985	NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000989	PC-420
AR–					
20342-02	14:52434	*See* PB–89-218002/XAB			
BALUF-STS–					
87-06	14:53231	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90604898	
BLM/LV/PT–					
88/014/8500	14:52392	*See* PB–89-217939/XAB			
89/007/1610	14:52391	*See* PB–89-215156/XAB			
BMI–					
2153	14:52279	*See* NUREG/CR–4949			
BNL–					
41797-Rev.	14:52968	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001546	MF-414
42124	14:52032	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001561	MF-401
42381	14:53688	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89009532	MF-414
42450	14:52533	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001327	MF-404; MF-414
42465	14:53047	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001325	MF-414
42544	14:52639	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001268	MF-404
42547	14:52640	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000533	
42905	14:52759	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000529	MF-401
42928	14:52609	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001326	MF-404
42942	14:52989	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001557	MF-405
42943	14:53106	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001547	MF-406

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43240	14:53138	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001534	MF-402
43247	14:53107	NTIS, PC A03/MF A01; OSTI; INIS		DE90001266	MF-406; MF-401
43249	14:53002	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001270	MF-414
43251	14:52641	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001328	MF-401; MF-404
43259	14:52642	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001571	MF-404
43263	14:53670	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001265	MF-414
43269	14:53003	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001530	MF-410
43271	14:53316	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001272	MF-408
43275	14:53048	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001324	MF-414
43276	14:53049	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001267	MF-414
43279	14:53050	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001263	MF-414
43280	14:53051	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001262	MF-414
43282	14:53770	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000767	MF-413
43284	14:52534	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001323	MF-404
43285	14:53004	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001329	MF-414
43287	14:52990	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001264	MF-414
43292	14:53689	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000759	MF-414
43312	14:52610	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001562	MF-404
43316	14:53108	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001559	MF-406
43318	14:53005	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001550	MF-406
43321	14:52991	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001553	MF-406
43327	14:53109	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001551	MF-406
43328	14:52948	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001556	MF-406
43330	14:53317	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001549	MF-406; MF-408
43336	14:53006	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001555	MF-406
43337	14:53110	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001554	MF-406
43339	14:53111	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001552	MF-406
43371	14:53007	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001558	MF-414
BONN-IR–					
89-01	14:53062	Bonn Univ. (Germany, F.R.). Physikalisches Inst.			
BR–					
82(11.105)	14:53249	OSTI - US Fish and Wildlife Service, NASA-Slidell Computer Complex, 1010 Gause Blvd., Slidell, LA 70458		TI90001668	
82(11.106)	14:53250	OSTI - US Fish and Wildlife Services, NASA-Slidell Computer Complex, 1010 Gause Blvd., Slidell, LA 70458		TI90001150	
82(11.108)	14:53251	OSTI - US Fish and Wildlife Service, NASA-Slidell Computer Complex, 1010 Gause Blvd., Slidell, LA 70458		TI90001151	
82(11.109)	14:53252	OSTI; US Fish and Wildlife Service, NASA-Slidell Computer Complex, 1010 Gause Blvd., Slidell, LA 70458		TI90001472	
82(11.110)	14:53253	OSTI; US Fish and Wildlife Service, NASA-Slidell Computer Complex, 1010 Gause Blvd., Slidell, LA 70458		TI90001471	
82-(11.112)	14:53254	OSTI - US Fish and Wildlife Service, NASA-Slidell Computer Complex, 1010 Gause Boulevard, Slidell, LA 70458		TI90001667	
BUMINES-IC–					
9219	14:51691	*See* PB–89-201479/XAB			
BUMINES-OFR–					
24-89	14:52387	*See* PB–89-204002/XAB			
BUMINES-RI–					
9226	14:51690	*See* PB–89-201420/XAB			
9233	14:51689	*See* PB–89-201396/XAB			
9234	14:51688	*See* PB–89-201388/XAB			
9235	14:52574	*See* PB–89-201370/XAB			
9237	14:51687	*See* PB–89-201354/XAB			
9238	14:51686	*See* PB–89-201347/XAB			
BIBoS–					
363/89	14:53724	Bielefeld Univ. (Germany, F.R.). Forschungszentrum Bielefeld-Bochum-Stochastik (BiBoS)			
CEBAF-PR–					
88-021	14:53015	*See* DOE/ER/40150–90			
88-022	14:53016	*See* DOE/ER/40150–91			
89-017	14:52971	*See* DOE/ER/40150–92			
89-018	14:52992	*See* DOE/ER/40150–93			

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89-019	14:52993	*See* DOE/ER/40150–94			
89-020	14:53017	*See* DOE/ER/40150–95			
89-021	14:53018	*See* DOE/ER/40150–96			
89-024	14:53019	*See* DOE/ER/40150–99			
89-026	14:53020	*See* DOE/ER/40150–101			
89-027	14:53021	*See* DOE/ER/40150–102			
89-028	14:53022	*See* DOE/ER/40150–103			
CEGB-RD/B–					
6081/R88	14:52187	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90606792	
6112/R89	14:53428	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE90606487	
CEGB-RD/L–					
3303/R88	14:53279	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90606539	
3342/R88	14:52247	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90606781	
3352/R88	14:52188	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90606793	
3429/R88	14:52923	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90606750	
CEGB-TPRD/L–					
3284/R88	14:52535	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90606336	
CENBG–					
88-24	14:53637	NTIS (US Sales Only), PC A02/MF A01		DE90713786	
88-26	14:53821	NTIS (US Sales Only), PC A03/MF A01		DE90713768	
88-27	14:53789	NTIS (US Sales Only), PC A03/MF A01		DE90713778	
CERN–					
89-07	14:52966	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE90606758	
CERN-TH–					
5185/88	14:53713	*See* UWThPh–1988-29			
CERN/LEP-MA–					
88-54	14:53008	NTIS (US Sales Only), PC A02/MF A01 - OSTI		DE90000114	
CESI–					
85-44	14:52156	NTIS (US Sales Only), PC A03		DE89793138	
86-15	14:52854	NTIS (US Sales Only), PC A03/MF A01		DE89761910	
86-17	14:52855	NTIS (US Sales Only), PC A02/MF A01		DE89761911	
CNIC–					
00192	14:51736	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE90604721	
00193	14:52924	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90605322	
00195	14:52234	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90605395	
00196	14:53063	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE90605571	
00206	14:53928	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE90603238	
00207	14:53918	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE90602935	
00209	14:53986	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90603380	
00211	14:53690	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE90603518	
00212	14:53691	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE90603519	
00213	14:53717	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE90603010	
00216	14:53420	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90604926	
00217	14:53692	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE90603520	
00219	14:53693	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE90603521	
00221	14:51737	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE90604722	
00228	14:53725	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE90602982	

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CONF-8111245–		(10. Symposium of Geology in Northeast; Recife (Brazil); Nov 1981)			
	14:51738	*See* INIS-BR–1656			
CONF-8510511–		(CEE workshop on potential, state of the art and R and D requirements for fuel cells in the European community; Noordwijkerhout (Netherlands); 7-8 Oct 1985)			
1	14:52430	*See* ETDE-IT–89-11			
CONF-8510512–		(1. European conference on power electronics and applications; Bruxelles (Belgium); 16-18 Oct 1985)			
1	14:52951	*See* ETDE-IT–89-12			
CONF-8510514–		(Conference on tribology: the story of lubrication and wear; Cleveland, OH (USA); 18 Oct 1985)			
	14:52487	*See* N–89-24635			
CONF-8511350–		(Workshop of the Italian Electrotechnical Association: fire and electric plants; Milan (Italy); 13-14 Nov 1985)			
1	14:52156	*See* CESI–85-44			
CONF-8603260–		(6. general conference of the Condensed Matter Division of the EPS; Stockholm (Sweden); 22-26 Mar 1986)			
	14:52540	*See* ENEA-RT-TIB–88-15			
CONF-8604414–		(7. All-Union Mendeleev's discussion on main modern trends in development of science of solutions; Leningrad (USSR); 10-15 Apr 1986)			
	14:52818	*See* INIS-SU–123			
CONF-860610–		(American Nuclear Society annual meeting; Reno, NV (USA); 15-20 Jun 1986)			
Summs.	14:54021				
Summs.	14:54022				
Summs.	14:54023				
Summs.	14:54024				
CONF-8606424–		(Meeting on the future of low voltage and medium voltage switchgear; Pavia (Italy); 16-18 Jun 1986)			
2	14:52854	*See* CESI–86-15			
3	14:52855	*See* CESI–86-17			
CONF-860903–		(IEEE-Industry Applications Society annual meeting; Denver, CO (USA); 28 Sep - 2 oct 1986)			
4	14:52953	*See* ETDE-IT–89-22			
CONF-8609396–		(European conference on optics, optical systems and applications; Florence (Italy); 30 Sep - 3 oct 1986)			
1	14:52899	*See* ENEA-RT-TIB–86-57			
CONF-8704351–		(Structure and properties of low rank coals; Denver, CO (USA); 5-10 Apr 1987)			
	14:51669				
	14:51670				
CONF-8704353–		(American Chemical Society Division of Fuel Chemistry; Denver, CO (USA); 5-10 Apr 1987)			
	14:51657				
	14:51658				
CONF-8707218–		(Consultants' meeting on fallout radioactivity monitoring in environment and food; Cadarache (France); 15-17 Jul 1987)			
	14:53421	*See* IAEA-AL–017			
CONF-870804–		(22. intersociety energy conversion engineering conference; Philadelphia, PA (USA); 10-14 Aug 1987)			
50	14:52513	*See* ETDE-IT–89-13			
CONF-8708341–		(4. international symposium on selected topics in statistical mechanics; Dubna (USSR); 25-29 Aug 1987)			
	14:54047	*See* JINR-D–17-88-95			
CONF-8709452–		(8. international round table on hydraulic transients in power stations; Madeira (Portugal); 14-17 Sep 1987)			
1	14:52142	*See* ETDE-IT–89-09			

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CONF-870959–		(1. international conference on neutron physics; Kiev (USSR); 14-18 Sep 1987)			
	14:53861	*See* INIS-SU–119/A			
CONF-8710274–		(2. international conference on elastic and diffractive scattering; New York, NY (USA); 15-18 Oct 1987)			
	14:53704	*See* IPNO-TH–88-02			
CONF-8710458–		(Studies on environmental radioactivity and health impact with reference to Chernobyl accident meeting; Rome (Italy); 12-13 Oct 1987)			
	14:53232	NTIS (US Sales Only), PC A20		DE89793223	
CONF-871110–		(3. international conference on facility operations safeguards interface; San Diego, CA (USA); 29 Nov - 4 dec 1987)			
	14:51880				
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	14:51938				
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CONF-871124–		(Fall meeting of the Materials Research Society; Boston, MA (USA); 30 Nov - 5 dec 1987)			
107	14:51783	*See* WHC-SA–0142			
108	14:52874	*See* WHC-SA–0143			
CONF-8711245–		(Workshop on computers applications for nuclear powers and industrial process plant operation and control; Rome (Italy); 19-20 Nov 1987)			
8	14:54072	*See* ETDE-IT–89-10			
CONF-8801171–		(Conference on solitons and chaotic behavior in optical systems; San Jose, CA (USA); 6-7 Jan 1988)			
1	14:53896	*See* LA-UR–89-3175			
CONF-8802155–		(4. Meeting between French and German Physicists and Mathematicians; Marseille (France); 29 Feb - 4 mar 1988)			
	14:53922	*See* LAPP-TH–224-88			
CONF-880314–		(Corrosion '88: National Association of Corrosion Engineers meeting; St. Louis, MO (USA); 21-25 Mar 1988)			
	14:51788	National Assoc. of Corrosion Engineers, P.O. Box 218340, Houston, TX 77218			
	14:52580	National Assoc. of Corrosion Engineers, P.O. Box 218340, Houston, TX 77218			
	14:52581	National Assoc. of Corrosion Engineers, P.O. Box 218340, Houston, TX 77218			
	14:52582	National Assoc. of Corrosion Engineers, P.O. Box 218340, Houston, TX 77218			
	14:52962	National Assoc. of Corrosion Engineers, P.O. Box 218340, Houston, TX 77218			
	14:52963	National Assoc. of Corrosion Engineers, P.O. Box 218340, Houston, TX 77218			
CONF-880326–		(4. symposium on integrated environmental control; Washington, DC (USA); 2-4 Mar 1988)			
	14:51677	*See* EPRI-GS–6519			
CONF-880348–		(American Institute of Chemical Engineers spring national meeting; New Orleans, LA (USA); 6-10 Mar 1988)			
	14:51680	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			
	14:52036	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			
	14:52042	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			
	14:52044	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			
	14:52508	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			
	14:52509	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			
CONF-8804122–		(9. space photovoltaic research and technology conference: high efficiency, space environment, and array technology; Cleveland, OH (USA); 19-21 Apr 1988)			
	14:52065	*See* N–89-24704			
CONF-8804156–		(19. annual IEEE power electronics specialists conference; Kyoto (Japan); 11-14 Apr 1988)			
1	14:52952	*See* ETDE-IT–89-14			
CONF-8804184–		(9. workshop on grand unification; Aix-Les-Bains (France); 27-30 Apr 1988)			
	14:53719	*See* LAPP-TH–225-88			
CONF-8805335–		(Workshop on the effects of undulators storage ring dynamics; Berkeley, CA (USA); 17-20 May 1988)			
1	14:52995	*See* LBL–25888			
CONF-880601–		(American Nuclear Society annual meeting; San Diego, CA (USA); 12-16 Jun 1988)			
	14:51745				

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	14:51746				
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CONF-880615–		(Solar '88: American Solar Energy Society annual meeting; Cambridge, MA (USA); 17-24 Jun 1988)			
7	14:52115	*See* ETDE-IT–89-04			
CONF-8806200–		(International Atomic Energy Authority meeting on sodium fires; Obninsk (USSR); 6-7 Jun 1988)			
	14:53440	*See* INIS-SU–116/A			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-8806243–		(DPF summer study: Snowmass '88: high energy physics in the 1990s; Snowmass, CO (USA); 27 Jun - 15 jul 1988)			
45	14:53010	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001064	MF-414
CONF-8806434–		(NASA/SDIO space environmental effects on materials workshop; Hampton, VA (USA); 28 Jun - 1 jul 1988)			
	14:52554	*See* N–89-23528			
	14:52561	*See* N–89-23547			
CONF-880665–		(33. international power source symposium; Cherry Hill, NJ (USA); 13-16 Jun 1988)			
5	14:52105	*See* ETDE-IT–89-08			
CONF-8807136–		(ISEC '88: international solvent extraction conference; Moscow (USSR); 18-24 Jul 1988)			
	14:52541	*See* ETDE-IT–89-07			
CONF-8807193–		(Conference on stochastic processes - geometry and physics; Como (Italy); Jul 1988)			
	14:53724	*See* BiBoS–363/89			
CONF-880732–		(Spectroscopic and diffraction techniques in interfacial electrochemistry; Puerto de la Cruz (Spain); 3-15 Jul 1988)			
3	14:52536	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001414	MF-404
CONF-880736–		(12. international cryogenic engineering conference and exhibition; Southampton (UK); 12-15 Jul 1988)			
7	14:54004	*See* ETDE-IT–89-01			
CONF-8808104–		(3. bioprocessing of coals workshop; Tysons Corners, VA (USA); 15-17 Aug 1988)			
	14:51621	NTIS, PC A13/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000890	MF-102; MF-108
CONF-880812–		(Applied superconductivity conference; San Francisco, CA (USA); 21-25 Aug 1988)			
45	14:52858	*See* ETDE-IT–89-15			
CONF-8808272–		(BNL Workshop on Glueballs, Hybrids and Exotic Hadrons; Brookhaven, U (USA); 29 Aug - 1 sep 1988)			
	14:53705	*See* LAPP-EXP–88-20			
CONF-880867–		(24. international Rochester conference on high energy physics; Munich (Germany, F.R.); 4-10 Aug 1988)			
	14:53675	*See* LAPP-EXP–88-12			
	14:53676	*See* LAPP-EXP–88-19			
CONF-880874–		(14. annual underground coal gasification symposium; Schaumburg, IL (USA); 15-18 Aug 1988)			
	14:51625	*See* DOE/METC–88/6097			
CONF-880896–		(JAERI international symposium on heavy-ion reaction dynamics in tandem energy region; Hitachi (Japan); 1-3 Aug 1988)			
	14:53821	*See* CENBG–88-26			
CONF-880912–		(196. American Chemical Society national meeting; Los Angeles, CA (USA); 25-30 Sep 1988)			
	14:52711	*See* IAEA-AL–019			
CONF-8809380–		(4. conference of roentgenologists and radiologists of Byelorussian SSR; Grodno (USSR); 8 Sep 1988)			
	14:53320	*See* INIS-SU–115/A			
CONF-880955–		(International conference on the physics of multiply charged ions and international workshop on E.C.R. ion sources; Grenoble (France); 12-16 Sep 1988)			
	14:53637	*See* CENBG–88-24			
CONF-8810179–		(International conference on nuclear fission: fifty years of progress in energy security; Washington, DC (USA); 30 Oct - 4 nov 1988)			
	14:51740				
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Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
	14:52401				
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CONF-8810196–		(Magnet design workshop; Vancouver (Canada); 3-5 Oct 1988)			
3	14:53008	*See* CERN/LEP-MA–88-54			
CONF-881020–		(4. international symposium on radiation physics (ISRP-4); Sao Paulo (Brazil); 3-7 Oct 1988)			
	14:53093				
CONF-881031–		(8. topical meeting on technology of fusion energy; Salt Lake City, UT (USA); 9-13 Oct 1988)			
72	14:52288	*See* WHC-SA–0368			
CONF-8810399–		(4. advances in laser science; Atlanta, GA (USA); Oct 1988)			
	14:53905	American Inst. of Physics, 335 E. 45th St., New York, NY 10017			
CONF-881049–		(14. linear accelerator conference (LINAC-14); Williamsburg, VA (USA); 3-7 Oct 1988)			
76	14:53017	*See* DOE/ER/40150–95			
77	14:53021	*See* DOE/ER/40150–102			
78	14:53022	*See* DOE/ER/40150–103			
79	14:52992	*See* DOE/ER/40150–93			
80	14:52971	*See* DOE/ER/40150–92			
CONF-881066–		(12. international symposium on the scientific basis for nuclear waste management; Berlin (Germany, F.R.); 10-13 Oct 1988)			
	14:52569	*See* NSS-R–136			
CONF-8811125–		(Rare decay symposium; Vancouver (Canada); 30 Nov - 3 dec 1988)			
6	14:53688	*See* BNL–42381			
CONF-8811203–		(American Nuclear Society (ANS) aluminium cladding corrosion workshop; Idaho Falls, ID (USA); 16-17 Nov 1988)			
	14:52284	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001281	MF-400; MF-404
CONF-8811251–		(7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy; Moscow (USSR); Moscow (USSR); 14 Nov 1988; 14 nov 1988)			
	14:52530	*See* INIS-SU–122/A			
CONF-8811252–		(7. All-Union conference on crystal growth; Symposium on molecular beam epitaxy; Moscow (USSR); Moscow (USSR); 14 Nov 1988; 14 nov 1988)			
	14:52530	*See* INIS-SU–122/A			
CONF-8811269–		(Intensive seminar on 'tree rings'; Kumatori (Japan); 29-30 Nov 1988)			
	14:53240	*See* KURRI-TR–316			
CONF-8811270–		(Workshop of the International School of Materials Science and Technology; Erice (Italy); 2-7 Nov 1988)			
1	14:52954	*See* LBL–26140			
CONF-8811274–		(IAEA basic international safeguards training course; Tashkent (USSR); 14-25 Nov 1988)			
	14:51879	*See* SAAS–376			
CONF-881133–		(2. international conference on improved coal-fired power plants; Palo Alto, CA (USA); 2-4 Nov 1988)			
Vol.1	14:52138	*See* EPRI-GS–6422-Vol.1			
Vol.2	14:52139	*See* EPRI-GS–6422-Vol.2			
CONF-881143–		(American Institute of Chemical Engineers annual meeting; Washington, DC (USA); 27 Nov - 2 dec 1988)			
	14:52909	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-881190–		(3. Japan-US workshop on tritium radiobiology and health physics; Kyoto (Japan); 8-10 Nov 1988)			
	14:53497	*See* IPPJ-REV–3			
CONF-8812101–		(Specialists' workshop on phase transition studies on hydrogen-bonded crystals by neutron and X-ray diffractometries; Kumatori (Japan); 12-13 Dec 1988)			
	14:52649	*See* KURRI-TR–312			
CONF-8901120–		(27. international winter meeting on nuclear physics; Bormio (Italy); 23-27 Jan 1989)			
	14:53753	*See* ISN–89-15			
CONF-890130–		(13. annual conference on composites and advanced ceramics; Cocoa Beach, FL (USA); 15-18 Jan 1989)			
	14:52656	*See* N–89-23622			
CONF-890211–		(4. international photovoltaic science and engineering conference; Sydney (Australia); 14-17 Feb 1989)			
	14:52108	*See* N–89-23517			
CONF-8902139–		(Distinguished-speaker colloquium series; Minneapolis, MN (USA); 2 Feb 1989)			
1	14:53681	*See* SLAC-PUB–5082			
CONF-8903138–		(ILL workshop on fundamental physics with slow neutrons; Grenoble (France); 8-11 Mar 1989)			
	14:53695	*See* HD-PY–89/03			
CONF-8903150–		(Workshop on neutron beam design, development and performance for neutron capture therapy; Cambridge, MA (USA); 30-31 Mar 1989)			
4	14:53316	*See* BNL–43271			
CONF-8903169–		(3. international symposium on domain decomposition; Houston, TX (USA); 20-22 Mar 1989)			
1	14:53661	*See* UCRL–101976			
CONF-890326–		(Solid particle erosion of steam turbines components workshop; New Orleans, LA (USA); 7-9 Mar 1989)			
	14:52140	*See* EPRI-GS–6535			
CONF-890335–		(13. particle accelerator conference; Chicago, IL (USA); 20-23 Mar 1989)			
257	14:52968	*See* BNL–41797-Rev.			
258	14:53020	*See* DOE/ER/40150–101			
259	14:52993	*See* DOE/ER/40150–94			
CONF-8904112–		(30. structures, structural dynamics and materials conference; Mobile, AL (USA); 3-5 Apr 1989)			
	14:52531	*See* N–89-24626			
CONF-8904156–		(CSNI-CEC specialist meeting on trends and pattern analyses of operational data from nuclear power plants; Rome (Italy); 3-7 Apr 1989)			
31	14:52291	NTIS (US Sales Only), PC A03/MF A01		DE89793181	
37	14:52292	NTIS (US Sales Only), PC A03/MF A01		DE89793188	
40	14:52136	NTIS (US Sales Only), PC A03/MF A01		DE89793107	
CONF-8904252–		(Conference on nomenclature for physical mapping of complex genomes; Rockville, MD (USA); 13-14 Apr 1989)			
Summ.	14:53287	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015173	MF-408
CONF-8904272–		(International high-level radioactive waste management conference; Las Vegas, NV (USA); 18-21 Apr 1989)			
1	14:51778	*See* SAND–89-2135C			
CONF-8904275–		(Symposium on ion beam processing of advanced electronic materials; San Diego, CA (USA); 25-27 Apr 1989)			
	14:52538	NTIS, PC A17/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89017342	MF-404
CONF-8904277–		(Program on string and conformal field theory; Copenhagen (Denmark); Apr 1989)			
	14:53720	*See* NORDITA–89/21-P(prepr.)			
CONF-890468–		(16. international conference on metallurgical coatings and equipment exhibit; San Diego, CA (USA); 17-21 Apr 1989)			
	14:52118	*See* N–89-24451			
	14:52657	*See* N–89-23691			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-8905136–		(Joint NEA/CEC workshop on sealing of radioactive waste repositories; Braunschweig (Germany, F.R.); 22-25 May 1989)			
1	14:51776	*See* SAND–89-1257			
CONF-8905141–		(5. international conference on electrostatic accelerators and associated boosters; Strasbourg (France); 24-27 May 1989)			
5	14:52970	*See* DOE/ER/40048–229-L9			
CONF-8905143–		(NATO advanced study institute international advanced course on the nuclear equation of state; Peniscola (Spain); 12 May - 3 jun 1989)			
18	14:53086	*See* LBL–27620			
CONF-8905144–		(Tau-Charm workshop; Stanford, CA (USA); 23-27 May 1989)			
13	14:53710	*See* SLAC-PUB–5088			
14	14:53680	*See* SLAC-PUB–5061			
CONF-8905183–		(Workshop on physics at the main injector; Batavia, IL (USA); 16-18 May 1989)			
4	14:53689	*See* BNL–43292			
CONF-8905187–		(WEIN '89: international symposium on weak and electromagnetic interactions in nuclei; Montreal (Canada); 15-19 May 1989)			
4	14:53711	*See* TRI-PP–89-51			
CONF-8905218–		(IAEA research coordination meeting on X- and gamma-ray standards for detector efficiency calibration; Braunschweig (Germany, F.R.); 31 May - 2 jun 1989)			
	14:53883	*See* INDC(NDS)–221			
CONF-8905219–		(Conference on CP violation in particle physics and astrophysics; Blois (France); 22-26 May 1989)			
1	14:53679	*See* SLAC-PUB–5000			
CONF-8905220–		(KEK topical conference on e^+e_- collision physics; Tsukuba (Japan); 17-19 May 1989)			
1	14:53682	*See* SLAC-PUB–5087			
CONF-8905222–		(Topical seminar on astrophysics and particle physics; San Miniato (Italy); 8-12 May 1989)			
1	14:53589	*See* FNAL/C–89/188-T			
CONF-8905223–		(12. Warsaw symposium on elementary particle physics; Kazimierz (Poland); 29 May - 2 jun 1989)			
1	14:53718	*See* FNAL/C–89/167-T			
CONF-8905225–		(NATO advanced summer school on applications of statistical and field theory to condensed matter; Evora (Portugal); May 1989)			
1	14:53897	*See* LA-UR–89-3249			
CONF-890545–		(6. conference on real-time computer applications in nuclear, particle and plasma physics; Williamsburg, VA (USA); 15-19 May 1989)			
17	14:53019	*See* DOE/ER/40150–99			
CONF-890572–		(1. annual fuel cells contractors review meeting; Morgantown, WV (USA); 2-4 May 1989)			
	14.52428	*See* DOE/METC–89/6105			
CONF-8906105–		(2. international symposium on polymer electrolytes; Siena (Italy); 14-16 Jun 1989)			
1	14:52639	*See* BNL–42544			
2	14:52642	*See* BNL–43259			
CONF-8906160–		(Yamada conference on nuclear weak process and nuclear structure; Osaka (Japan); 12-15 Jun 1989)			
3	14:53843	*See* TRI-PP–89-53			
4	14:53712	*See* TRI-PP–89-52			
5	14:53761	*See* TRI-PP–89-54			
6	14:53757	*See* TRI-PP–89-65			
CONF-8906168–		(International conference on selected topics in nuclear structure; Dubna (USSR); 20-24 Jun 1989)			
4	14:53758	*See* TRI-PP–89-69			
5	14:53754	*See* JINR-E–3-89-506			
CONF-8906169–		(International Astronautics Federation conference on space power; Cleveland, OH (USA); 5-7 Jun 1989)			
	14:52028	*See* N–89-23518			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
	14:52113	*See* N–89-23516			
CONF-8906180–		(U.S. EPA/ORNL workshop on municipal waste combustion: deposition, food chain impacts, uncertainty, and research needs; Cincinnati, OH (USA); 8-9 Jun 1989)			
2	14:53556	*See* UCRL–100678			
CONF-8906194–		(International meeting on physics at KAON; Bad Honnef (Germany, F.R.); 7-9 Jun 1989)			
2	14:53670	*See* BNL–43263			
CONF-8906204–		(International symposium on heavy quark physics; Ithaca, NY (USA); 13-17 Jun 1989)			
4	14:53684	*See* SLAC-PUB–5094			
5	14:53683	*See* SLAC-PUB–5093			
CONF-8906205–		(NATO advanced study institute on lower-dimensional systems and molecular electronics; Spetses (Greece); 12-23 Jun 1989)			
2	14:52641	*See* BNL–43251			
CONF-8906223–		(Conference on statistical issues in quantitative cancer risk assessment; Snowbird, UT (USA); 18-22 Jun 1989)			
1	14:53302	*See* UCRL–101590			
CONF-8906225–		(Physics of classical novae: IAU colloquium no. 122; Madrid (Spain); 27-30 Jun 1989)			
1	14:53600	*See* LA-UR–89-3200			
CONF-8906229–		(Symposium on high temperature composites; Dayton, OH (USA); 13-15 Jun 1989)			
	14:52658	*See* N–89-24460			
CONF-890701–		(International cryogenic materials conference; Los Angeles, CA (USA); 24-28 Jul 1989)			
9	14:52533	*See* BNL–42450			
10	14:53034	*See* LBL–26619			
13	14:52552	*See* LBL–27381			
CONF-890708–		(16. international conference on the physics of electronic and atomic collisions; New York, NY (USA); 26 Jul - 1 aug 1989)			
9	14:53650	*See* LBL–27553			
CONF-890710–		(5. international conference on megagauss magnetic field generation and related topics; Novosibirsk (USSR); 3-7 Jul 1989)			
21	14:52996	*See* SAND–88-3305C			
CONF-8907103–		(Technology-based confidence building: energy and environment; Santa Fe, NM (USA); 9-14 Jul 1989)			
9	14:53118	*See* UCRL–101137			
11	14:53230	*See* UCRL–101850			
CONF-8907113–		(5. international conference on environmental mutagens; Cleveland, OH (USA); 10-15 Jul 1989)			
12	14:53300	*See* UCRL–101728			
CONF-8907116–		(22. annual international Metallographic Society meeting; Charlotte, NC (USA); 23 Jul 1989)			
5	14:52612	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001606	MF-366
CONF-8907118–		(25. American Society of Mechanical Engineers joint propulsion conference; Monterey, CA (USA); 10-13 Jul 1989)			
	14:52030	*See* N–89-24445			
CONF-8907150–		(12. course of the International School of Nuclear Physics: the nature of hadrons and nuclei studied by electron scattering; Erice (Italy); 16-25 Jul 1989)			
1	14:53840	*See* LA-UR–89-3198			
CONF-8907154–		(Enrico Fermi summer course CX11: nuclear collisions from the mean field into the fragmentation regime; Varenna (Italy); 11-21 Jul 1989)			
1	14:53841	*See* LBL–27502			
CONF-890718–		(International conference on materials and mechanisms of superconductivity - high-temperature superconductors; Stanford, CA (USA); 23-28 Jul 1989)			
31	14:52622	*See* LBL–27541			

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CONF-890802–		(7. synchrotron radiation instrumentation (SRI) national conference; Berkeley, CA (USA); 6-10 Aug 1989)			
1	14:53085	*See* LBL–27581			
2	14:53007	*See* BNL–43371			
3	14:53108	*See* BNL–43316			
4	14:52991	*See* BNL–43321			
5	14:53006	*See* BNL–43336			
6	14:53317	*See* BNL–43330			
7	14:53005	*See* BNL–43318			
8	14:52948	*See* BNL–43328			
9	14:52989	*See* BNL–42942			
10	14:53110	*See* BNL–43337			
11	14:53111	*See* BNL–43339			
12	14:53106	*See* BNL–42943			
CONF-890803–		(International conference on high energy accelerators; Tsukuba (Japan); 20-26 Aug 1989)			
20	14:52999	*See* SLAC-PUB–5091			
21	14:52977	*See* SLAC-PUB–5075			
22	14:53038	*See* SLAC-PUB–5070			
23	14:52998	*See* SLAC-PUB–5056			
24	14:52990	*See* BNL–43287			
25	14:53058	*See* LBL–27670			
26	14:53057	*See* LBL–27665			
27	14:53004	*See* BNL–43285			
28	14:53009	NTIS, PC A02/MF A01; OSTI; INIS		DE90001067	MF-414
29	14:52972	*See* FNAL/C–89/198			
30	14:53047	*See* BNL–42465			
31	14:53048	*See* BNL–43275			
32	14:53049	*See* BNL–43276			
33	14:53050	*See* BNL–43279			
34	14:53051	*See* BNL–43280			
CONF-890809–		(9. international conference on vacuum ultraviolet radiation physics; Honolulu, HI (USA); 14-18 Aug 1989)			
2	14:53109	*See* BNL–43327			
CONF-8908103–		(4. joint Swedish/Soviet international workshop on information theory; Gutland (Sweden); 27 Aug - 1 sep 1989)			
2	14:54061	*See* SAND–89-2288C			
CONF-8908106–		(Los Alamos workshop on quantum simulations of condensed matter phenomena; Los Alamos, NM (USA); 8-11 Aug 1989)			
2	14:53895	*See* LA-UR–89-3094			
4	14:53653	*See* UCRL–101905			
CONF-890811–		(9. international symposium on detonation; Portland, OR (USA); 28 Aug - 1 sep 1989)			
40	14:53125	*See* UCRL–99559			
CONF-8908133–		(24. Yamada conference on strongly coupled plasma physics; Tokyo (Japan); 29 Aug - 2 sep 1989)			
4	14:53052	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001409	MF-413
CONF-8908134–		(11. international free electron laser conference; Naples, FL (USA); 28 Aug - 1 sep 1989)			
5	14:52902	*See* LA-UR–89-2851			
6	14:52978	*See* UCRL–101066			
7	14:53039	*See* UCRL–101193			
CONF-890815–		(24. intersociety energy conversion engineering conference; Arlington, VA (USA); 6-11 Aug 1989)			
	14:52110	*See* N–89-24427			
	14:52928	*See* N–89-25078			
CONF-8908155–		(Ecological Society of America meeting; Toronto (Canada); 3 Aug 1989)			
1	14:53218	*See* DP-MS–88-239			
CONF-8908158–		(Conference on microscopic simulation of complex flows; Brussels (Belgium); 21-25 Aug 1989)			
1	14:53660	*See* UCRL–101907			
CONF-8908160–		(2. conference on non-destructive evaluation for aerospace requirements; Huntsville, AL (USA); 22-24 Aug 1989)			
2	14:52935	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001335	MF-406

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-8908163–		(7. symposium on turbulent shear flows; Stanford, CA (USA); 21-23 Aug 1989)			
	14:52927	*See* N–89-24577			
CONF-890821–		(13. international conference on atomic collisions in solids; Aarhus (Denmark); 7-11 Aug 1989)			
4	14:53904	*See* SAND–89-0854C			
5	14:53023	*See* FNAL/C–89/162			
CONF-890826–		(International nuclear physics conference; Sao Paulo (Brazil); 20-26 Aug 1989)			
4	14:53745	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001410	MF-413
CONF-890841–		(International workshop on safety of nuclear installations of the next generation and beyond; Chicago, IL (USA); 28-31 Aug 1989)			
2	14:53138	*See* BNL–43240			
CONF-890861–		(13. biennial international conference on amorphous and liquid semiconductors (ICALS-13) and the first international conference on amorphous semiconductor technology (ICAST-1); Asheville, NC (USA); 21-26 Aug 1989)			
3	14:52643	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001413	MF-404; MF-406
CONF-890872–		(Workshop on physics at Fermilab in the 1990's; Breckenridge, CO (USA); 15-24 Aug 1989)			
1	14:53025	*See* FNAL-TM–1624			
CONF-890901–		(14. world energy conference; Montreal (Canada); 17-22 Sep 1989)			
1	14:53187	*See* PNL-SA–16496-1			
CONF-890903–		(International Europhysics conference on high-energy physics; Madrid (Spain); 7-14 Sep 1989)			
1	14:53671	*See* DOE/ER/13065–586			
CONF-8909110–		(16. annual conference of the American Society for Quality Control; Fort Lauderdale, FL (USA); 17-20 Sep 1989)			
6	14:51787	*See* WSRC-RP–89-782			
CONF-8909113–		(14. international pyrotechnics seminar; Jersey (UK); 18-22 Sep 1989)			
5	14:53123	*See* MLM–3607(OP)			
6	14:53122	*See* MLM–3606(OP)			
CONF-8909128–		(Oceans '89 conference; Seattle, WA (USA); 18-21 Sep 1989)			
2	14:53273	*See* PNL-SA–16636			
3	14:53571	*See* PNL-SA–17154			
CONF-8909141–		(12. international meeting on reduced enrichment for research and test reactors; Berlin (Germany, F.R.); 10-13 Sep 1989)			
1	14:52838	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001428	MF-526
CONF-890916–		(6. annual international Pittsburgh coal conference; Pittsburgh, PA (USA); 25-29 Sep 1989)			
2	14:51703	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001989	MF-101
CONF-8909163–		(5. symposium on containment of underground nuclear detonations; Santa Barbara, CA (USA); 19-21 Sep 1989)			
2	14:53572	*See* UCRL–101709			
5	14:53134	*See* UCRL–100795			
CONF-8909169–		(18. North American Thermal Analysis Society conference; San Diego, CA (USA); 24-27 Sep 1989)			
3	14:53124	*See* MLM–3608(OP)			
CONF-8909172–		(SIMS VII: 7th international conference on secondary ion mass spectrometry; Monterey, CA (USA); 3-8 Sep 1989)			
2	14:52578	*See* UCRL–100796			
CONF-8909180–		(ANL conference on the prevention of significant safety-related events in the operation of US Department of Energy nuclear facilities; Richland, WA (USA); 11-14 Sep 1989)			
1	14:53540	*See* WHC-SA–0527			
CONF-890920–		(14. international conference on organic geochemistry; Paris (France); 18-22 Sep 1989)			
1	14:51733	*See* UCRL–99776			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-8909200–		(Workshop on national priorities and technological change: fostering flexibility in the engineering work force; Washington, DC (USA); 29 Sep 1989)			
1	14:52373	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000709	MF-400
CONF-8909208–		(American Water Resources Association conference; Tampa, FL (USA); 17-22 Sep 1989)			
1	14:52289	*See* DP-MS–88-242			
CONF-8909210–		(12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989)			
1	14:53859	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001076	MF-411
2	14:53860	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001001	MF-411
3	14:54001	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001338	MF-420
CONF-8909211–		(5. international tunable laser conference; Irkutsk (USSR); 20-23 Sep 1989)			
1	14:52897	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001078	
2	14:52908	*See* UCRL–100786			
CONF-8909213–		(ESNET/DECNET working group meeting; Stanford, CA (USA); 7-8 Sep 1989)			
1	14:54041	*See* GA-A–19829			
CONF-8909214–		(Washington risk assessment conference; Arlington, VA (USA); 27 Sep 1989)			
1	14:53227	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001074	
CONF-8909216–		(DARPA/SDIO service annual charged particle beam review; Monterey, CA (USA); 18-21 Sep 1989)			
1	14:53652	*See* SAND–89-2155C			
3	14:53035	*See* SAND–89-2127C			
4	14:52997	*See* SAND–89-2114C			
5	14:53036	*See* SAND–89-2181C			
CONF-8909217–		(Canadian Wind Energy Association conference; Charlottetown (Canada); 18-21 Sep 1989)			
1	14:52135	*See* SAND–89-1535C			
CONF-8909221–		(HADRON '89: 3rd international conference on hadron spectroscopy; Ajaccio (France); 23-27 Sep 1989)			
1	14:53672	*See* DOE/ER/13065–592			
CONF-8909226–		(5. conference on superoxide and superoxide dismutase; Jerusalem (Israel); 17-22 Sep 1989)			
1	14:52759	*See* BNL–42905			
CONF-8909227–		(Integrated environmental management meeting; Aiken, SC (USA); 26-28 Sep 1989)			
1	14:53217	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000579	MF-402
CONF-8909241–		(5. Brazilian Meeting on Analytical Chemistry; Salvador (Brazil); 4-6 Sep 1989)			
	14:52723	*See* INIS-BR–1642			
	14:52724	*See* INIS-BR–1649			
CONF-890928–		(Nuclear waste isolation in the unsaturated zone: FOCUS '89; Las Vegas, NV (USA); 18-21 Sep 1989)			
5	14:51777	*See* SAND–89-1915C			
6	14:51754	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001016	MF-721
7	14:51774	*See* PNL-SA–16663			
8	14:51759	*See* DP-MS–89-73			
CONF-890933–		(International conference on the applications of the Mossbauer effect (ICAME '89); Budapest (Hungary); 4-8 Sep 1989)			
4	14:53770	*See* BNL–43282			
CONF-890939–		(International conference on high T_c thin films and single crystals; Ustron (Poland); 30 Sep - 4 oct 1989)			
1	14:52611	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89017584	MF-404; MF-410
CONF-890940–		(9. international symposium on air breathing engines (ISABE-9); Athens (Greece); 4-9 Sep 1989)			
	14:52926	*See* N–89-23465			
CONF-890953–		(International conference on the physics of highly correlated electron systems; Santa Fe, NM (USA); 11-15 Sep 1989)			
7	14:53638	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001446	MF-401; MF-404

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-890981–		(Windpower '89; San Francisco, CA (USA); 24-27 Sep 1989)			
2	14:52133	*See* SAND–89-0986C			
2	14:52610	*See* BNL–43312			
CONF-890982–		(International meeting on neutron activation cross section for fission and fusion energy applications; Argonne, IL (USA); 11-15 Sep 1989)			
3	14:53819	*See* UCRL–101613			
CONF-890994–		(Simulation fidelity workshop III; Colorado Springs, CO (USA); 19-21 Sep 1989)			
1	14:52955	*See* SAND–89-1976C			
CONF-891006–		(Joint international waste management conference; Kyoto (Japan); 23-28 Oct 1989)			
6-Rev.1	14:51758	*See* DP-MS–88-160-Rev.1			
CONF-891007–		(13. international symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989)			
6	14:54013	*See* UCRL–101131			
10	14:54012	*See* UCRL–101099			
13	14:53929	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001353	MF-421
14	14:54015	*See* UCRL–101241			
15	14:54014	*See* UCRL–101136			
17	14:53987	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001595	MF-420
18	14:53936	*See* GA-A–19546			
19	14:53988	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001653	MF-420
20	14:53989	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001637	MF-420
21	14:53990	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001626	MF-421
25	14:53991	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001738	MF-420
26	14:53992	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001740	MF-420
27	14:53993	NTIS, PC A03/MF A01; OSTI; INIS		DE90001728	MF-420
28	14:53994	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001969	MF-420
29	14:53995	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001970	MF-420
30	14:53996	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001972	MF-420
32	14:53997	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001962	MF-420
33	14:53998	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001961	MF-421
34	14:53999	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001966	MF-426
CONF-8910103–		(Supercomputing conference; San Francisco, CA (USA); 16-20 Oct 1989)			
2	14:54059	*See* PNL-SA–17406			
CONF-8910126–		(3. joint US-CERN school on particle accelerators: frontiers of particle beams, observation, diagnosis, and correction; Capri (Italy); 20-26 Oct 1989)			
2	14:52976	*See* SLAC-PUB–4946			
CONF-891013–		(6. symposium on separation science and technology for energy applications; Knoxville, TN (USA); 22-27 Oct 1989)			
2	14:52760	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001732	MF-400
3	14:52761	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001954	MF-311
CONF-8910192–		(2. DOE natural phenomena hazards mitigation conference; Knoxville, TN (USA); 3-5 Oct 1989)			
5	14:52293	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000566	MF-402; MF-403
6	14:52294	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000567	MF-520
10	14:53573	*See* WHC-SA–0600			
CONF-8910193–		(DOE model conference; Oak Ridge, TN (USA); 2-6 Oct 1989)			
2	14:52960	NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000702	MF-721
CONF-8910195–		(AAPG Rocky Mountain Section meeting; Albuquerque, NM (USA); 1-4 Oct 1989)			
	14:51708				
	14:51713				
CONF-8910196–		(Electronic imaging '89; Boston, MA (USA); 2-5 Oct 1989)			
2	14:53117	*See* UCRL–99801			
CONF-8910219–		(Linac conference; Williamsburg, VA (USA); 3 Oct 1989)			
1	14:53016	*See* DOE/ER/40150–91			
2	14:53018	*See* DOE/ER/40150–96			
3	14:53015	*See* DOE/ER/40150–90			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-8910223–		(BIOTECH USA: 6th annual industry conference and exhibition; San Francisco, CA (USA); 2-4 Oct 1989)			
1	14:53415	*See* LA-UR–89-3192			
CONF-8910225–		(IAEA technical committee meeting on ICRH/edge physics; Munich (Germany, F.R.); 2-5 Oct 1989)			
1	14:53937	*See* GA-A–19826			
CONF-8910229–		(40. congress of the International Astronautical Federation; Malaga (Spain); 7-13 Oct 1989)			
1	14:53601	*See* LA-UR–89-3288			
CONF-8910232–		(Tri-service corrosion conference; Atlantic City, NJ (USA); 17-19 Oct 1989)			
1	14:52640	*See* BNL–42547			
CONF-8910233–		(South Eastern simulation conference; Pensacola, FL (USA); 16-17 Oct 1989)			
1	14:52203	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000578	MF-505
CONF-8910237–		(International school seminar on heavy ion physics; Dubna (USSR); 3-12 Oct 1989)			
1	14:53844	*See* UCRL–101906			
CONF-891024–		(The Metallurgical Society fall meeting: materials week; Indianapolis, IN (USA); 1-5 Oct 1989)			
2	14:52537	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001736	MF-404
3	14:52539	*See* DP-MS–89-41			
CONF-8910240–		(Fundamental relationships between microstructure and mechanical properties of metal matrix composites; Indianapolis, IN (USA); 1-5 Oct 1989)			
1	14:52551	*See* LA-UR–89-3123			
CONF-891034–		(5. European conference on biomass for energy and industry; Lisbon (Portugal); 9-13 Oct 1989)			
1	14:52032	*See* BNL–42124			
CONF-891037–		(21. international technical conference of the Society for the Advancement of Materials and Process Engineering (SAMPE); Atlantic City, NJ (USA); 17-19 Oct 1989)			
1	14:52654	*See* MLM–3605(OP)			
CONF-891042–		(31. ORNL/DOE conference on analytical chemistry in energy technology; 3. annual Colorado Hazardous Waste Management Society conference; Gatlinburg, TN (USA); , CO (USA); 10-12 Oct 1989; 6-7 nov 1989)			
1	14:51775	*See* RFP–4344			
2	14:53256	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001333	MF-402
3	14:52413	*See* PNL-SA–17173			
Absts.	14:52708	NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001007	MF-401
CONF-891046–		(Advanced research and technology development; Morgantown, WV (USA); 3-5 Oct 1989)			
1	14:51620	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000706	MF-106
CONF-891064–		(12. national computer security conference; Baltimore, MD (USA); 10-13 Oct 1989)			
2	14:54049	*See* LA-UR–89-527			
CONF-891082–		(International conference on new trends in liquid scintillation counting and organic scintillators; Gatlinburg, TN (USA); 2-5 Oct 1989)			
2	14:52281	*See* WSRC-RP–89-397			
CONF-891087–		(IEEE nuclear science symposium and exhibits; San Francisco, CA (USA); 25-27 Oct 1989)			
2	14:54053	*See* LBL–27696			
4	14:52949	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001601	
5	14:52950	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001630	
CONF-891093–		(36. American Vacuum Society national vacuum symposium; Boston, MA (USA); 23-27 Oct 1989)			
3	14:54000	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001358	MF-421
4	14:52609	*See* BNL–42928			
5	14:52534	*See* BNL–43284			
6	14:52576	*See* SAND–89-1322C			
CONF-891101–		(Geological Society of America annual meeting; St. Louis, MO (USA); 6-9 Nov 1989)			
1	14:51755	NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89014542	MF-814
CONF-891103–		(Winter meeting of the American Nuclear Society; San Francisco, CA (USA); 26-30 Nov 1989)			
30-Rev.1	14:53209	*See* UCRL–101215-Rev.1			

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CONF-891106–		(31. annual meeting of the Division of Plasma Physics of the American Physical Society; Anaheim, CA (USA); 13-17 Nov 1989)			
Absts.	14:53962	*See* UCLA/PPG–1263			
CONF-891111–		(International gas research conference; Tokyo (Japan); 6-9 Nov 1989)			
1	14:51732	*See* LBL–27274			
CONF-891113–		(American Institute of Chemical Engineers annual meeting; San Francisco, CA (USA); 5-10 Nov 1989)			
1	14:52431	*See* LA-UR–89-2947			
2	14:53139	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001062	MF-402
CONF-891118–		(International meeting on nuclear criticality safety margins; San Francisco, CA (USA); 26 Nov - 1 dec 1989)			
7	14:51742	*See* LA-UR–89-2712			
CONF-891120–		(Migration '89: 2nd international conference on chemistry and migration behavior of actinides and fission products in the geosphere; Monterey, CA (USA); 6-10 Nov 1989)			
1	14:53241	*See* LA-UR–89-3049			
CONF-891127–		(Einstein to AXAF conference; Cambridge, MA (USA); Nov 1989)			
1	14:53599	*See* LA-UR–89-863			
CONF-891132–		(9. battery and electrochemical contractors' conference; Alexandria, VA (USA); 13-17 Nov 1989)			
1	14:52368	*See* SAND–89-1852C			
2	14:52371	*See* SAND–89-7103C			
3	14:52369	*See* SAND–89-1886C			
4	14:52370	*See* SAND–89-1914C			
5	14:52623	*See* LBL–27585			
6	14:52367	*See* LBL–27593			
Summs.	14:52366	NTIS, PC A15/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016837	MF-212; PC-212
CONF-891133–		(9. electric vehicle symposium; Toronto (Canada); 13-16 Nov 1989)			
1	14:52521	*See* EGG-M–88114			
CONF-891134–		(INS international symposium on nuclear physics at intermediate energy; Tokyo (Japan); 15-17 Nov 1989)			
1	14:53677	*See* LA-UR–89-1304			
CONF-891148–		(11. annual international conference of the IEEE Engineering in Medicine and Biology Society; Seattle, WA (USA); 9-12 Nov 1989)			
1	14:53406	*See* LA-UR–89-1520			
CONF-891149–		(Supercomputing '89 conference; Reno, NV (USA); 13-17 Nov 1989)			
1	14:54051	*See* LA-UR–89-1829			
2	14:54050	*See* LA-UR–89-1627			
3	14:53116	*See* SAND–89-1423C			
4	14:54052	*See* LA-UR–89-2974			
6	14:53731	*See* LA-UR–89-3311			
7	14:54062	*See* UCRL–101911			
CONF-891151–		(Nearly integrable systems and applications; Minneapolis, MN (USA); 7-11 Nov 1989)			
1	14:53923	*See* LA-UR–89-1664			
CONF-891152–		(60. shock and vibration symposium; Virginia Beach, VA (USA); 14-16 Nov 1989)			
1	14:52870	*See* SAND–89-1641C			
3	14:52872	*See* SAND–89-1678C			
4	14:52873	*See* SAND–89-1680C			
5	14:52871	*See* SAND–89-1656C			
CONF-891153–		(2. topical conference on emerging technologies in materials; San Francisco, CA (USA); 6-9 Nov 1989)			
1	14:52663	*See* UCRL–101108			
CONF-891159–		(GOMAC '89: government microcircuit applications conference; Orlando, FL (USA); 7-9 Nov 1989)			
2	14:53098	*See* SAND–89-2011C			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-891192–		(Annual Westinghouse computer symposium; Pittsburgh, PA (USA); 6-7 Nov 1989)			
1	14:54063	*See* WSRC-RP–89-451			
2	14:53119	*See* WSRC-RP–89-463			
3	14:54065	*See* WSRC-RP–89-516			
4	14:54076	*See* WSRC-RP–89-467			
5	14:51784	*See* WSRC-RP–89-457			
6	14:54064	*See* WSRC-RP–89-461			
7	14:52876	*See* WSRC-RP–89-483			
8	14:52257	*See* WSRC-RP–89-474			
9	14:52875	*See* WSRC-RP–89-464			
10	14:51786	*See* WSRC-RP–89-660			
11-Rev.1	14:52857	*See* DP-MS–89-5-Rev.1			
13	14:52256	*See* WSRC-RP–89-473			
14	14:52176	*See* DP-MS–89-4-Rev.1			
16	14:54077	*See* WSRC-RP–89-472			
17	14:51785	*See* WSRC-RP–89-468			
CONF-891193–		(31. ORNL/DOE conference on analytical chemistry in energy technology; 3. annual Colorado Hazardous Waste Management Society conference; Gatlinburg, TN (USA); , CO (USA); 10-12 Oct 1989; 6-7 nov 1989)			
1	14:51775	*See* RFP–4344			
COO–					
3380-60	14:53431	*See* DOE/ER/60539–T1			
CPT–					
88/PE.2158	14:53713	*See* UWThPh–1988-29			
CRIE-T–					
87068	14:51695	NTIS (US Sales Only), PC A03/MF A01		DE89782320	
87106	14:51673	NTIS (US Sales Only), PC A03/MF A01		DE89782316	
CRIE-U–					
13	14:51674	NTIS (US Sales Only), PC A05/MF A01		DE89782325	
CRN-HE–					
88-06	14:53053	NTIS (US Sales Only), PC A03/MF A01		DE90713792	
89-01	14:53726	NTIS (US Sales Only), PC A03/MF A01		DE90713772	
CRN-PN–					
88-19	14:53064	NTIS (US Sales Only), PC A03/MF A01		DE90713794	
CRN-VIV–					
52	14:53011	NTIS (US Sales Only), PC A03/MF A01		DE90713795	
53	14:53012	NTIS (US Sales Only), PC A02/MF A01		DE90713796	
57	14:52969	NTIS (US Sales Only), PC A03/MF A01		DE90713799	
61	14:53013	NTIS (US Sales Only), PC A02/MF A01		DE90713793	
CSA–					
88-11-03	14:52853	*See* AD-A–208937/3/XAB			
CTA-IEAv-RP–					
09/85	14:53014	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE90606766	
CUCS–					
415-89	14:54030	*See* AD-A–209132/0/XAB			
DCN–					
87-203-024-81-02	14:53184	*See* PB–89-217897/XAB			
DESY-SR–					
89-02	14:53054	Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)			
DHHS/PUB/NIOSH–					
88-118-SUPPL-1-OHG	14:53418	*See* PB–89-203129/XAB			
89-104-SUPPL-2-OHG	14:53419	*See* PB–89-203137/XAB			
DOE-RW–					
89.025(pt.3)	14:51752	*See* AERE-R–12961			
89/007	14:52569	*See* NSS-R–136			
DOE/AL/10752–					
42	14:51756	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001211	MF-702
DOE/BC/10849–					
15	14:51709	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000765	PC-122
DOE/BC/14126–					
11	14:51714	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000768	PC-122
12	14:51715	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000766	PC-122
13	14:51716	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000767	PC-122
DOE/BC/14304–					
T4	14:53257	NTIS, PC A07/MF A01 - OSTI		DE90001544	MF-121

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/BC/14425–					
1	14:51710	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001230	MF-122
DOE/BP/16380–					
3	14:52157	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017659	MF-908
4	14:52158	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017660	MF-908
DOE/BP/37379–					
T1	14:52047	NTIS, PC A08/MF A01 - OSTI		DE89017701	MF-902
DOE/BP/38372–					
1	14:52048	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017653	MF-908
DOE/BP/91945–					
1	14:52049	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017656	MF-908
DOE/CE–					
0245-3	14:52409	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001870	MF-350
DOE/CE/15270–					
T11	14:52055	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001155	MF-242
DOE/CE/26593–					
T1	14:52502	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001201	MF-350
DOE/EA–					
0331	14:52148	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001106	MF-630
0364	14:52856	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001107	MF-630
0372	14:53284	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001108	MF-630
0386	14:53285	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001109	MF-630
0409	14:51730	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001111	MF-630
0410	14:52121	NTIS, PC A03/MF A01 - OSTI		DE90001112	MF-630
DOE/EH–					
0098	14:52378	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000864	MF-607
0102	14:53150	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000951	MF-603
0107	14:53237	NTIS, PC A21/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000987	MF-630
DOE/EIA–					
0035(89/05)	14:52420	NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE90002124	MF-950
0125(89/2Q)	14:52414	NTIS, PC A06/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE90001487	MF-950
0226(89/07)	14:52417	NTIS, PC A08/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE90002123	MF-950
0376(87)	14:52421	NTIS, PC A12/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000748	MF-950
0380(89/05)	14:51720	NTIS, PC A09/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE90001526	MF-950
0380(89/07)	14:51721	NTIS, PC A09/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE90001473	MF-950
0436(89)	14:51735	NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001286	MF-950
0487(88)	14:51722	NTIS, PC A18/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE90001650	MF-950
0529	14:51681	NTIS, PC A04/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE90001587	MF-950
DOE/ER–					
0313/6	14:54002	NTIS, PC A17/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000976	PC-423; PC-424
DOE/ER/01112–					
1989	14:53667	NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001120	MF-414; MF-405
DOE/ER/02504–					
475	14:53668	NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001398	MF-414
DOE/ER/10713–					
9A	14:53727	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001116	MF-414
DOE/ER/10742–					
7	14:53886	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001456	MF-411; MF-404
DOE/ER/13065–					
586	14:53671	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001134	MF-414
592	14:53672	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001578	MF-414
DOE/ER/13192–					
28	14:53639	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001232	MF-411
DOE/ER/13332–					
T2	14:53640	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001221	MF-411
DOE/ER/13476–					
1	14:52056	NTIS, PC A03/MF A01 - OSTI		DE90001204	MF-408
DOE/ER/13629–					
3	14:52837	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001234	MF-401
DOE/ER/13653–					
3	14:52762	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001225	MF-401
DOE/ER/13668–					
T1	14:52472	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001197	MF-401
T2	14:52473	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001505	MF-401
DOE/ER/13678–					
31	14:52709	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001231	MF-401
DOE/ER/13765–					
1	14:53303	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001200	MF-408

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DOE/ER/13832–					
9	14:52763	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001101	MF-401
DOE/ER/13833–					
3	14:52710	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001102	MF-401
DOE/ER/13839–					
2	14:53658	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001399	MF-406
DOE/ER/25061–					
2	14:54040	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017440	
DOE/ER/30131–					
T8	14:52898	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001154	MF-406
DOE/ER/40048–					
229-L9	14:52970	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89017273	MF-414
DOE/ER/40145–					
4	14:53746	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001402	MF-413
DOE/ER/40150–					
101	14:53020	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000758	MF-414
102	14:53021	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000757	MF-414
103	14:53022	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000756	MF-414
90	14:53015	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000769	MF-414
91	14:53016	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000771	MF-414
92	14:52971	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000766	MF-414
93	14:52992	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000765	MF-414
94	14:52993	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000764	MF-414
95	14:53017	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000763	MF-414
96	14:53018	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000770	MF-414
99	14:53019	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000760	MF-414
DOE/ER/40233–					
4	14:53728	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001455	MF-414
DOE/ER/40269–					
T2	14:53747	NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001944	MF-413
DOE/ER/40283–					
8	14:53694	NTIS, PC A18/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001695	MF-413
DOE/ER/40285–					
3	14:53748	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001233	MF-413
DOE/ER/40330–					
34	14:53790	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001229	MF-413
DOE/ER/40343–					
3	14:53749	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001401	MF-413
DOE/ER/40418–					
2	14:53776	NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001397	MF-413
DOE/ER/40425–					
244	14:53822	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001670	MF-413
DOE/ER/45090–					
1	14:52613	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001206	MF-404
DOE/ER/45102–					
T2	14:52614	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001521	MF-401; MF-405
DOE/ER/45266–					
T2	14:52615	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001669	MF-404
DOE/ER/45283–					
4	14:52645	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001525	MF-404
DOE/ER/52127–					
60	14:53930	NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001226	MF-420
DOE/ER/53222–					
100	14:54003	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90002135	MF-427
DOE/ER/53223–					
113	14:53931	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001113	MF-420
DOE/ER/60248–					
T1	14:53412	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001198	MF-402
DOE/ER/60304–					
5	14:53151	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001228	MF-402
H1	14:53135	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000998	PC-402
DOE/ER/60315–					
1	14:53429	NTIS, PC A21/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000628	MF-402
DOE/ER/60405–					
4	14:53430	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001119	MF-402
DOE/ER/60407–					
3	14:53318	NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001207	MF-408
DOE/ER/60408–					
1	14:53301	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001227	MF-408

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DOE/ER/60539–					
T1	14:53431	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001535	MF-408
DOE/ER/60592–					
T2	14:53546	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001152	MF-407
DOE/ER/60698–					
1	14:52436	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001199	MF-408
DOE/ER/69017–					
1	14:53152	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001205	MF-402
DOE/ET/51013–					
275	14:53932	NTIS, PC A09/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001711	MF-426
DOE/FE–					
0137	14:51622	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000952	PC-101
0143	14:51704	NTIS, PC A13/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000949	PC-101
0144	14:51696	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000997	PC-101
DOE/FTR–					
90000101	14:52295	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000101	
90001701	14:53669	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001701	MF-414
DOE/ID/12296–					
5	14:52474	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016730	PC-310; PC-310
DOE/ID/12621–					
2	14:52475	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000742	MF-311
DOE/ID/12626–					
4	14:52476	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017426	PC-311; PC-311
DOE/ID/12701–					
1	14:52477	NTIS, PC A05/MF A01 - OSTI		DE90000555	PC-311; PC-311
DOE/MA–					
0383	14:52410	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000908	MF-900
DOE/MC/21353–					
2669	14:51734	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000948	PC-123; PC-123
DOE/MC/23075–					
2744	14:51623	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001209	MF-109
DOE/MC/23288–					
2741	14:51624	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001104	MF-109
DOE/METC–					
88/6097	14:51625	NTIS, PC A18/MF A01 - OSTI; GPO Dep.	E 1.99:	DE88001093	MF-109
89/6105	14:52428	NTIS, PC A17/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011699	MF-110
DOE/OR/21548–					
078	14:51858	NTIS, PC A08/MF A01; OSTI; INIS		DE90001125	MF-511
082	14:51859	NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001010	MF-502
DOE/PC/79905–					
T8	14:51659	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001161	MF-102
DOE/PC/79916–					
6	14:51697	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000027	MF-113
DOE/PC/79918–					
T5	14:51675	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000044	MF-109
DOE/PC/79936–					
5	14:51626	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000082	MF-108
DOE/PC/80502–					
T15	14:51627	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001664	MF-108
DOE/PC/88810–					
3	14:51637	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001129	MF-108
DOE/PC/88818–					
3	14:51638	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001407	MF-108
DOE/PC/88827–					
T3	14:51719	NTIS, PC A03/MF A01 - OSTI		DE90001160	MF-125
DOE/PC/88867–					
T4	14:52149	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001159	MF-105
DOE/PC/88868–					
T2	14:51676	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001467	MF-105
DOE/PC/88878–					
T4	14:51619	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001157	MF-113
DOE/PC/88915–					
T4	14:51639	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001223	MF-109
DOE/PC/88919–					
T2	14:51640	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001082	MF-102
DOE/PC/88924–					
4	14:51665	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001404	MF-113

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DOE/PC/88929–					
T2	14:51698	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001459	MF-103
DOE/PC/88949–					
T3	14:51685	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001085	MF-114
DOE/PC/88951–					
2	14:51693	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001405	MF-114
DOE/PC/90502–					
12	14:51666	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001462	MF-102
DOE/PC/90507–					
T12	14:51667	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001156	MF-102
DOE/PC/90534–					
13	14:51641	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001378	MF-115
DOE/PC/90958–					
T9	14:51694	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000720	MF-114
DOE/RL–					
88-03	14:51860	NTIS, PC A04/MF A01 - OSTI		DE90001136	MF-511
88-23	14:51861	NTIS, PC A12/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000762	MF-511
89-14-Draft-A	14:51757	NTIS, PC A16/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001139	MF-510
DOE/SSDP–					
0076	14:52296	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000546	MF-511
DP–					
1766-Rev.1	14:52276	NTIS, PC A99/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017822	MF-702
DP-MS–					
88-160-Rev.1	14:51758	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001381	MF-721
88-239	14:53218	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017861	MF-708
88-242	14:52289	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000657	MF-702
89-4-Rev.1	14:52176	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017840	MF-706
89-41	14:52539	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001312	MF-704
89-5-Rev.1	14:52857	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017845	MF-706
89-73	14:51759	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001380	MF-721; MF-702
DTP–					
89-18	14:53709	*See* RAL–89-047			
DTRC–					
89/004	14:52424	*See* AD-A-209499/3/XAB			
E–					
4535	14:52487	*See* N–89-24635			
4587	14:52065	*See* N–89-24704			
4686	14:52657	*See* N–89-23691			
4689	14:52926	*See* N–89-23465			
4707	14:52028	*See* N–89-23518			
4724	14:54079	*See* N–89-24443			
4730	14:52113	*See* N–89-23516			
4744	14:52108	*See* N–89-23517			
4764	14:52118	*See* N–89-24451			
4775	14:52658	*See* N–89-24460			
4787	14:52030	*See* N–89-24445			
4796	14:52656	*See* N–89-23622			
4859	14:52928	*See* N–89-25078			
4912	14:52927	*See* N–89-24577			
4933	14:52110	*See* N–89-24427			
ECE/GE–					
89-32232/3185e	14:51705	NTIS (US Sales Only), PC A06/MF A01 - OSTI		DE90002113	
EEG–					
42	14:51756	*See* DOE/AL/10752–42			
EEO-ED–					
133/211	14:52480	NTIS (US Sales Only), PC A03/MF A01		DE90709244	
134/226	14:52481	NTIS (US Sales Only), PC A03/MF A01		DE90709242	
141/214	14:52482	NTIS (US Sales Only), PC A03/MF A01		DE90709243	
166/191	14:52483	NTIS (US Sales Only), PC A04/MF A01		DE90709238	
184/186	14:52484	NTIS (US Sales Only), PC A04/MF A01		DE90709245	
191/217	14:52045	NTIS (US Sales Only), PC A03/MF A01		DE90709246	
193/187	14:52485	NTIS (US Sales Only), PC A04/MF A01		DE90709239	
202/185	14:52486	NTIS (US Sales Only), PC A03/MF A01		DE90709240	
68/196	14:52478	NTIS (US Sales Only), PC A06		DE90709234	
83/180	14:52479	NTIS (US Sales Only), PC A03/MF A01		DE90709241	
EGG–					
2575	14:52297	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000153	PC-721
EGG-CEMA–					
8510	14:53246	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016215	MF-502

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EGG-M–					
88114	14:52521	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011125	MF-96
ENEA-DOC-DISP–					
87-4	14:52150	NTIS (US Sales Only), PC A03/MF A01		DE89793017	
ENEA-RT-COMB–					
88-04	14:51744	NTIS (US Sales Only), PC A03/MF A01		DE89793108	
ENEA-RT-FUS–					
88-27	14:53659	NTIS (US Sales Only), PC A03/MF A01		DE89793066	
ENEA-RT-PAS–					
85-19	14:53275	NTIS (US Sales Only), PC A03/MF A01		DE89761996	
ENEA-RT-TIB–					
85-4	14:53575	NTIS (US Sales Only), PC A03/MF A01		DE89793116	
86-57	14:52899	NTIS (US Sales Only), PC A03		DE89761930	
88-15	14:52540	NTIS (US Sales Only), PC A04/MF A01		DE89761839	
EPA–					
450/2-89/011	14:53216	*See* PB–89-207914/XAB			
450/2-89/012A	14:53552	*See* PB–89-207161/XAB			
450/3-89-31	14:53212	NTIS, PC A09/MF A01 - OSTI		TI90001118	
530/SW-86/001	14:52381	*See* PB–89-213169/XAB			
530/SW-89/061	14:52507	*See* PB–89-220578/XAB			
560/4-89/005	14:52379	*See* PB–89-208144/XAB			
560/4-89/006	14:52380	*See* PB–89-208151/XAB			
600/3-85/019	14:53183	*See* PB–89-214431/XAB			
600/3-89/041	14:53262	*See* PB–89-198246/XAB			
600/3-89/057	14:53167	*See* PB–89-200828/XAB			
600/J-87/477	14:52522	*See* PB–89-201834/XAB			
600/J-88/253	14:53160	*See* PB–89-197743/XAB			
600/J-88/289	14:53159	*See* PB–89-197214/XAB			
600/J-88/312	14:52965	*See* PB–89-207252/XAB			
600/J-88/324	14:53175	*See* PB–89-206742/XAB			
600/J-88/325	14:53551	*See* PB–89-206734/XAB			
600/J-88/326	14:53174	*See* PB–89-206726/XAB			
600/J-88/327	14:53173	*See* PB–89-206718/XAB			
600/J-88/332	14:53172	*See* PB–89-206676/XAB			
600/J-88/335	14:53171	*See* PB–89-206643/XAB			
600/J-89/044	14:53261	*See* PB–89-197453/XAB			
910/9-88/216	14:53270	*See* PB–89-217962/XAB			
EPA/AA/CTAB–					
89/03	14:52523	*See* PB–89-207906/XAB			
89/04	14:52512	*See* PB–89-215396/XAB			
EPA/IMSD–					
89/001	14:53178	*See* PB–89-207476/XAB			
EPA/ROD/R–					
02-88/064	14:53247	*See* PB–89-188783/XAB			
EPA/ROD/RO–					
6-88/044	14:51770	*See* PB–89-206171/XAB			
EPRI-EN–					
6526	14:53153	Research Reports Center, Box 50490, Palo Alto, CA 94303			
EPRI-GS–					
6422-Vol.1	14:52138	Research Reports Center, Box 50490, Palo Alto, CA 94303			
6422-Vol.2	14:52139	Research Reports Center, Box 50490, Palo Alto, CA 94303			
6504	14:52429	Research Reports Center, Box 50490, Palo Alto, CA 94303			
6519	14:51677	Research Reports Center, Box 50490, Palo Alto, CA 94303			
6535	14:52140	Research Reports Center, Box 50490, Palo Alto, CA 94303			
6566	14:52141	Research Reports Center, Box 50490, Palo Alto, CA 94303			
EPRI-NP–					
6152-Vol.2	14:52298	Research Reports Center, Box 50490, Palo Alto, CA 94303			
6152-Vol.3	14:52299	Research Reports Center, Box 50490, Palo Alto, CA 94303			
6521	14:52300	Research Reports Center, Box 50490, Palo Alto, CA 94303			
6541-M	14:52301	Research Reports Center, Box 50490, Palo Alto, CA 94303			

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ETDE-IT–					
89-01	14:54004	NTIS (US Sales Only), PC A02/MF A01		DE89793195	
89-04	14:52115	NTIS (US Sales Only), PC A02/MF A01		DE89793121	
89-05	14:52437	NTIS (US Sales Only), PC A02		DE89793122	
89-07	14:52541	NTIS (US Sales Only), PC A02/MF A01		DE89793123	
89-08	14:52105	NTIS (US Sales Only), PC A02/MF A01		DE89793124	
89-09	14:52142	NTIS (US Sales Only), PC A03/MF A01		DE89793125	
89-10	14:54072	NTIS (US Sales Only), PC A02		DE89793126	
89-11	14:52430	NTIS (US Sales Only), PC A03		DE89793127	
89-12	14:52951	NTIS (US Sales Only), PC A02		DE89793129	
89-13	14:52513	NTIS (US Sales Only), PC A02/MF A01		DE89793131	
89-14	14:52952	NTIS (US Sales Only), PC A02		DE89793134	
89-15	14:52858	NTIS (US Sales Only), PC A02		DE89793137	
89-22	14:52953	NTIS (US Sales Only), PC A02		DE89793140	
ETDE-mf–					
0711180	14:52438	NTIS (US Sales Only), PC A10/MF A01		DE90711180	
0711711	14:53547	NTIS (US Sales Only), PC A04/MF A01		DE90711711	
ETN–					
89-94392	14:53602	*See* MPE-PREPRINT–131			
89-94394	14:53603	*See* MPE-PREPRINT–133			
ETSU-S–					
1128A	14:52054	British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ			
FCR–					
9643A	14:52435	*See* PB–89-218010/XAB			
FDA/CDRH–					
89/90	14:53408	*See* PB–89-205215/XAB			
FJSRL-TR–					
89-0005	14:52896	*See* AD-A–209129/6/XAB			
FNAL-TM–					
1605	14:53024	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001878	PC-414
1624	14:53025	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001874	PC-414
FNAL/C–					
89/162	14:53023	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001575	MF-414
89/167-T	14:53718	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000780	MF-412
89/188-T	14:53589	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000779	MF-412
89/198	14:52972	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001573	MF-414
FPEI-WP–					
31	14:52388	*See* PB–89-204325/XAB			
32	14:52389	*See* PB–89-204341/XAB			
FRNC-TH–					
3476	14:52131	NTIS (US Sales Only), PC A09/MF A01		DE90713658	
3478	14:52439	NTIS (US Sales Only), PC A10/MF A01		DE90713659	
3483	14:52057	NTIS (US Sales Only), PC A14/MF A01		DE90713660	
FS–					
89-50-AKU	14:53238	NTIS (US Sales Only), PC A03/MF A01		DE90711754	
GA-A–					
19546	14:53936	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001654	MF-420
19826	14:53937	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000755	MF-420
19829	14:54041	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001009	MF-405
GKSS–					
89/E/12	14:52285	NTIS (US Sales Only), PC A03/MF A01		DE90711708	
89/E/15	14:53258	NTIS (US Sales Only), PC A06/MF A01		DE90711709	
GRI–					
89/0164	14:51727	*See* PB–89-217947/XAB			
GRS–					
90000095	14:52302	NTIS (US Sales Only), PC A03/MF A01 - OSTI		DE90000095	
GSF–					
12/88	14:51761	NTIS (US Sales Only), PC A03/MF A01		DE90711224	
22/88	14:53204	NTIS (US Sales Only), PC A05/MF A01		DE90711225	
7/89	14:51760	NTIS (US Sales Only), PC A03/MF A01		DE90711759	
GSF-S–					
24/88	14:53876	NTIS (US Sales Only), PC A05/MF A01		DE90711226	
GTFR–					
92	14:53938	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001580	MF-420
HD-PY–					
89/03	14:53695	NTIS (US Sales Only), PC A03/MF A01		DE90711366	
HD-THEP–					
88-19	14:53696	Heidelberg Univ. (Germany, F.R.). Inst. fuer Theoretische Physik			

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HEDL–					
7639	14:52542	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001131	MF-504
IAE–					
4529-3	14:53877	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90606542	
IAEA-AL–					
017	14:53421	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90604920	
019	14:52711	NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS		DE90603824	
IBP-SA–					
1/1985	14:52616	NTIS (US Sales Only), PC A03/MF A01		DE90711216	
ICASE–					
89-20	14:54054	*See* N–89-24058			
IDA-P–					
2132	14:54078	*See* AD-A–209447/2/XAB			
IEE-SR–					
201	14:52411	NTIS (US Sales Only), PC A07/MF A01		DE89760374	
IEN-DQUI-DIQUI-NT–					
02/80	14:52718	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90606184	
IFVE-ONF/OTF–					
88-203	14:53697	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90603581	
IL/ENR/AE–					
86/01(88)	14:52423	*See* PB–89-208136/XAB			
INDC(NDS)–					
221	14:53883	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90605298	
INIS-BR–					
1625	14:52719	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE90606123	
1626	14:53887	NTIS (US Sales Only), PC A16/MF A01 - OSTI; INIS		DE90605723	
1635	14:53066	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90606822	
1636	14:52720	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE90606185	
1638	14:52721	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE90606128	
1639	14:52722	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE90606129	
1640	14:52617	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE90606349	
1642	14:52723	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE90606131	
1643	14:52839	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE90606219	
1644	14:52840	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE90606220	
1646	14:52841	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE90606222	
1647	14:53424	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE90606533	
1648	14:52842	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE90606223	
1649	14:52724	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE90606132	
1650	14:52544	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE90606340	
1651	14:52253	NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS		DE90606783	
1652	14:52725	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE90606133	
1654	14:52726	NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS		DE90606174	
1656	14:51738	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90606373	
1661	14:52843	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE90606224	
1662	14:53750	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90606110	

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1663	14:53067	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90606823	
1664	14:54073	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE90606936	
1665	14:52844	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE90606225	
1666	14:52764	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE90605724	
1667	14:52727	NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS		DE90606176	
1669	14:52728	NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS		DE90606188	
1670	14:52729	NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS		DE90606177	
1676	14:52860	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE90606754	
1678	14:52730	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE90606138	
1679	14:53884	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE90606543	
1680	14:52765	NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS		DE90605725	
1681	14:52731	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE90606139	
1682	14:52545	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE90606327	
INIS-GB–					
203	14:52448	British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ			
INIS-SU–					
115/A	14:53320	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE90705923	
116/A	14:53440	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE90705925	
119/A	14:53861	NTIS (US Sales Only), PC A16/MF A01 - OSTI; INIS		DE90705913	
122/A	14:52530	NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS		DE90705926	
123	14:52818	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE90705933	
128	14:52828	NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS		DE90705932	
131/A	14:53399	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE90705924	
INIS-mf–					
12000	14:52323	NTIS (US Sales Only), PC A03/MF A01		DE90711369	
12002	14:52936	NTIS (US Sales Only), PC A07/MF A01		DE90711230	
12003	14:52324	NTIS (US Sales Only), PC A07/MF A01		DE90711229	
12004	14:52732	NTIS (US Sales Only), PC A03/MF A01		DE90711663	
12006	14:53751	NTIS (US Sales Only), PC A09/MF A01		DE90711506	
IPEN-PUB–					
185	14:52937	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90606775	
251	14:53779	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90606117	
252	14:53083	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90606800	
253	14:52618	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90606358	
254	14:51762	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90606924	
256	14:51763	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90606894	
257	14:52549	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90606337	
259	14:51764	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90606925	
IPNO-DRE–					
88-41	14:53084	NTIS (US Sales Only), PC A03/MF A01		DE90713789	
89-06	14:53646	NTIS (US Sales Only), PC A03/MF A01		DE90713758	
89-07	14:53647	NTIS (US Sales Only), PC A03/MF A01		DE90713759	

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IPNO-TH–					
87-66	14:53596	NTIS (US Sales Only), PC A03/MF A01		DE90713773	
88-02	14:53704	NTIS (US Sales Only), PC A03/MF A01		DE90713775	
IPP–					
6/278	14:53939	Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)			
IPPJ–					
905	14:53940	NTIS (US Sales Only), PC A03/MF A01		DE90709986	
906	14:53941	NTIS (US Sales Only), PC A03/MF A01		DE90709985	
907	14:53942	NTIS (US Sales Only), PC A03/MF A01		DE90709984	
908	14:53943	NTIS (US Sales Only), PC A03/MF A01		DE90709983	
909	14:53944	NTIS (US Sales Only), PC A03/MF A01		DE90709988	
910	14:53945	NTIS (US Sales Only), PC A03/MF A01		DE90709987	
911	14:53946	NTIS (US Sales Only), PC A04/MF A01		DE90710052	
912	14:53947	NTIS (US Sales Only), PC A03/MF A01		DE90710053	
913	14:53948	NTIS (US Sales Only), PC A03/MF A01		DE90710054	
914	14:53949	NTIS (US Sales Only), PC A03/MF A01		DE90710055	
915	14:53950	NTIS (US Sales Only), PC A02/MF A01		DE90710056	
IPPJ-DT–					
148	14:53951	NTIS (US Sales Only), PC A03/MF A01		DE90709993	
149	14:54045	NTIS (US Sales Only), PC A04/MF A01		DE90709992	
IPPJ-REV–					
3	14:53497	NTIS (US Sales Only), PC A14/MF A01		DE90705927	
IPPJ-T–					
39	14:53952	NTIS (US Sales Only), PC A03/MF A01		DE90710051	
IR–					
141	14:54057	*See* PB–89-205249/XAB			
ISN–					
88-72	14:53838	NTIS (US Sales Only), PC A03/MF A01		DE90713762	
88-73	14:53648	NTIS (US Sales Only), PC A04/MF A01		DE90713761	
88-74	14:53752	NTIS (US Sales Only), PC A03/MF A01		DE90713790	
88-75	14:53649	NTIS (US Sales Only), PC A03/MF A01		DE90713760	
89-15	14:53753	NTIS (US Sales Only), PC A03/MF A01		DE90713779	
89-19	14:53921	NTIS (US Sales Only), PC A03/MF A01		DE90713763	
IYaF–					
89-23	14:53597	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE90606054	
JAERI-M–					
89-007	14:52189	NTIS (US Sales Only), PC A99/MF A01		DE90710050	
89-041	14:53206	NTIS (US Sales Only), PC A04/MF A01		DE90709989	
89-045	14:51862	NTIS (US Sales Only), PC A04/MF A01		DE90710036	
89-048	14:52177	NTIS (US Sales Only), PC A04/MF A01		DE90709982	
89-049	14:52286	NTIS (US Sales Only), PC A04/MF A01		DE90710038	
89-051	14:52325	NTIS (US Sales Only), PC A04/MF A01		DE90710058	
89-052	14:53288	NTIS (US Sales Only), PC A03/MF A01		DE90709981	
89-053	14:51945	NTIS (US Sales Only), PC A03/MF A01		DE90710046	
89-055	14:52163	NTIS (US Sales Only), PC A03/MF A01		DE90710031	
89-056	14:53953	NTIS (US Sales Only), PC A04/MF A01		DE90710037	
89-058	14:52707	NTIS (US Sales Only), PC A16/MF A01		DE90709980	
89-059	14:51739	NTIS (US Sales Only), PC A03/MF A01		DE90709979	
89-062	14:53207	NTIS (US Sales Only), PC A03/MF A01		DE90710045	
89-065	14:52925	NTIS (US Sales Only), PC A03/MF A01		DE90709990	
89-067	14:52862	NTIS (US Sales Only), PC A03/MF A01		DE90710044	
89-068	14:54046	NTIS (US Sales Only), PC A08/MF A01		DE90709991	
89-072	14:52235	NTIS (US Sales Only), PC A05/MF A01		DE90710071	
JHRP–					
87-11-ES	14:52495	*See* PB–89-207849/XAB			
87-11-F	14:52494	*See* PB–89-207831/XAB			
JINR-D–					
17-88-95	14:54047	NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS		DE90705928	
JINR-E–					
3-89-506	14:53754	NTIS (US Sales Only), PC A03/MF A01 - OSTI		DE90000716	
Juel–					
2245	14:52845	NTIS (US Sales Only), PC A06/MF A01		DE90711199	
2251	14:53289	NTIS (US Sales Only), PC A10/MF A01		DE90711181	
2281	14:52619	NTIS (US Sales Only), PC A06/MF A01		DE90711782	
Juel-Conf–					
64	14:52190	NTIS (US Sales Only), PC A06/MF A01		DE90711187	
Juel-Spez–					
478	14:52287	NTIS (US Sales Only), PC A03/MF A01		DE90711186	

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K/CSD/TM–					
64/Rev.3	14:54048	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001869	MF-505
K/ITP–					
181	14:51741	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001012	MF-701
KEK–					
88-14	14:53889	NTIS (US Sales Only), PC A07/MF A01		DE90709957	
KFK–					
4357	14:52211	NTIS (US Sales Only), PC A25/MF A01		DE90711598	
4580	14:52254	NTIS (US Sales Only), PC A04/MF A01		DE90711760	
4585	14:52326	NTIS (US Sales Only), PC A03/MF A01		DE90711707	
4596	14:52204	NTIS (US Sales Only), PC A04/MF A01		DE90711750	
4598	14:52620	NTIS (US Sales Only), PC A03/MF A01		DE90711706	
KURRI-TR–					
312	14:52649	NTIS (US Sales Only), PC A07/MF A01		DE90705930	
313	14:52653	NTIS (US Sales Only), PC A03/MF A01		DE90709976	
316	14:53240	NTIS (US Sales Only), PC A05/MF A01		DE90705931	
317	14:53862	NTIS (US Sales Only), PC A03/MF A01		DE90709975	
KY/L–					
1549	14:52550	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001406	MF-513
L–					
16572	14:53863	*See* N–89-24255			
16575-PT-1	14:52554	*See* N–89-23528			
16575-PT-2	14:52561	*See* N–89-23547			
16583	14:53842	*See* N–89-25103			
LA–					
11499-MS	14:52621	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000918	PC-704; PC-706
11639-MS	14:51877	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000990	PC-700
11665-SR	14:51765	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000947	PC-810
11679-PR	14:53568	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000871	MF-903
LA-UR–					
89-1304	14:53677	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89011175	MF-700
89-1520	14:53406	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012592	MF-708
89-1627	14:54050	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012614	MF-705
89-1664	14:53923	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013453	MF-410
89-1829	14:54051	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012633	MF-705
89-2712	14:51742	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89017000	MF-900
89-2851	14:52902	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000611	MF-706
89-2947	14:52431	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016779	MF-500
89-2974	14:54052	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016603	MF-705
89-3049	14:53241	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000601	MF-902
89-3094	14:53895	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001835	MF-405
89-3123	14:52551	NTIS, PC A03/MF A01 - OSTI		DE90001828	
89-3175	14:53896	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000694	MF-910
89-3192	14:53415	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000692	MF-905
89-3198	14:53840	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000691	MF-405; MF-413
89-3200	14:53600	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000690	MF-910
89-3249	14:53897	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000685	MF-405; MF-411
89-3288	14:53601	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000679	
89-3311	14:53731	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001825	MF-905
89-527	14:54049	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89007990	MF-700
89-863	14:53599	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009389	MF-702
LALP–					
89-14	14:52277	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001210	MF-700
LAPP-EXP–					
88-12	14:53675	NTIS (US Sales Only), PC A02/MF A01		DE90713782	
88-19	14:53676	NTIS (US Sales Only), PC A02/MF A01		DE90713783	
88-20	14:53705	NTIS (US Sales Only), PC A02/MF A01		DE90713770	
89-01	14:53033	NTIS (US Sales Only), PC A02/MF A01		DE90713765	
LAPP-TH–					
220-88	14:53598	NTIS (US Sales Only), PC A03/MF A01		DE90713777	
224-88	14:53922	NTIS (US Sales Only), PC A02/MF A01		DE90713787	
225-88	14:53719	NTIS (US Sales Only), PC A03/MF A01		DE90713784	
237-89	14:53730	NTIS (US Sales Only), PC A03/MF A01		DE90713766	
238-89	14:53839	NTIS (US Sales Only), PC A03/MF A01		DE90713767	
LBL–					
25888	14:52995	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001214	MF-414
26140	14:52954	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000549	MF-404
26619	14:53034	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001423	MF-406

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27274	14:51732	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014882	
27381	14:52552	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90002120	MF-404
27502	14:53841	NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000183	MF-413
27541	14:52622	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000166	MF-404
27553	14:53650	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001541	MF-411
27581	14:53085	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001422	MF-408
27585	14:52623	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000127	MF-213
27593	14:52367	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001014	MF-212
27607	14:52553	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001425	MF-404
27620	14:53086	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000557	MF-413
27665	14:53057	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001216	MF-414
27670	14:53058	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001215	MF-414
27694	14:53898	NTIS, PC A09/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001543	MF-414
27696	14:54053	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001421	MF-406
27723	14:53678	NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001572	MF-414
27760	14:53038	*See* SLAC-PUB–5070			
LBL-PUB–					
659-9/89	14:53414	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000130	MF-407
LLNL–					
90000164	14:52327	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000164	MF-714
90001492	14:53208	NTIS, PC A99/MF A01 - OSTI		DE90001492	MF-402; MF-405
LNCC–					
045/88	14:52863	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90606755	
LR–					
636(PA)M	14:53162	*See* PB–89-197909/XAB			
639(PA)M	14:52492	*See* PB–89-197016/XAB			
659(AP)M	14:53166	*See* PB–89-197990/XAB			
667(MR)M	14:52506	*See* PB–89-198345/XAB			
669(PA)M	14:52964	*See* PB–89-198360/XAB			
675(PA)M	14:52505	*See* PB–89-197974/XAB			
677(PA)M	14:53163	*See* PB–89-197941/XAB			
678(AP)M	14:53164	*See* PB–89-197958/XAB			
691(AP)M	14:53165	*See* PB–89-197966/XAB			
692(MR)M	14:52504	*See* PB–89-197875/XAB			
707(PA)M	14:53161	*See* PB–89-197883/XAB			
LUMEDW-MEOK–					
1007-1-79-1985	14:53407	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE90605244	
M–					
262	14:53208	*See* LLNL–90001492			
MAFF-AEPAM–					
5	14:52735	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90603913	
MIT/LCS/TR–					
438	14:54029	*See* AD-A–209117/1/XAB			
MLM–					
3605(OP)	14:52654	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001448	MF-704
3606(OP)	14:53122	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001450	MF-706
3607(OP)	14:53123	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001449	MF-742
3608(OP)	14:53124	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001447	MF-742
MPE-PREPRINT–					
131	14:53602	Fachinformationszentrum Karlsruhe, 7514 Eggenstein-Leopoldshafen 2, Federal Republic of Germany			
133	14:53603	Fachinformationszentrum Karlsruhe, 7514 Eggenstein-Leopoldshafen 2, Federal Republic of Germany			
MTL-TR–					
89-10	14:52608	*See* AD-A–209376/3/XAB			
N–					
89-23465	14:52926	NTIS, PC A03/MF A01			
89-23516	14:52113	NTIS, PC A03/MF A01			
89-23517	14:52108	NTIS, PC A02/MF A01			
89-23518	14:52028	NTIS, PC A03/MF A01			
89-23528	14:52554	NTIS, PC A16/MF A01			
89-23547	14:52561	NTIS, PC A12/MF A01			
89-23622	14:52656	NTIS, PC A03/MF A01			
89-23691	14:52657	NTIS, PC A02/MF A01			
89-23860	14:52903	NTIS, PC A05/MF A01			

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89-24058	14:54054	NTIS, PC A03/MF A01			
89-24142	14:53606	NTIS, PC A03/MF A01			
89-24162	14:53607	NTIS, PC A09/MF A01			
89-24233	14:53608	NTIS, PC A03/MF A01			
89-24251	14:53609	NTIS, PC A02/MF A01			
89-24255	14:53863	NTIS, PC A03/MF A01			
89-24260	14:53610	NTIS, PC A03/MF A01			
89-24427	14:52110	NTIS, PC A02/MF A01			
89-24435	14:52864	NTIS, PC A04/MF A01			
89-24443	14:54079	NTIS, PC A18/MF A01			
89-24445	14:52030	NTIS, PC A02/MF A01			
89-24451	14:52118	NTIS, PC A03/MF A01			
89-24460	14:52658	NTIS, PC A03/MF A01			
89-24577	14:52927	NTIS, PC A02/MF A01			
89-24599	14:52904	NTIS, PC A03/MF A01			
89-24601	14:52905	NTIS, PC A04/MF A01			
89-24626	14:52531	NTIS, PC A05/MF A01			
89-24635	14:52487	NTIS, PC A07/MF A01			
89-24669	14:52850	NTIS, PC A02/MF A01			
89-24673	14:52851	NTIS, PC A06/MF A01			
89-24677	14:52852	NTIS, PC A03/MF A01			
89-24704	14:52065	NTIS, PC A16/MF A01			
89-25051	14:53087	NTIS, PC A03/MF A01			
89-25078	14:52928	NTIS, PC A02/MF A01			
89-25079	14:53611	NTIS, PC A03/MF A01			
89-25103	14:53842	NTIS, PC A03/MF A01			
89-25104	14:53651	NTIS, PC A03/MF A01			
NAL-TR–					
961	14:53112	NTIS (US Sales Only), PC A03/MF A01		DE89772374	
968	14:52511	NTIS (US Sales Only), PC A03/MF A01		DE89772377	
NAS–					
1.15:100327	14:52864	*See* N–89-24435			
1.15:100368	14:53610	*See* N–89-24260			
1.15:100643	14:52851	*See* N–89-24673			
1.15:101430	14:52487	*See* N–89-24635			
1.15:101548	14:52852	*See* N–89-24677			
1.15:101559	14:53651	*See* N–89-25104			
1.15:101986	14:52657	*See* N–89-23691			
1.15:101987	14:52926	*See* N–89-23465			
1.15:102003	14:52028	*See* N–89-23518			
1.15:102012	14:54079	*See* N–89-24443			
1.15:102016	14:52113	*See* N–89-23516			
1.15:102019	14:52108	*See* N–89-23517			
1.15:102032	14:52658	*See* N–89-24460			
1.15:102082	14:52118	*See* N–89-24451			
1.15:102097	14:52928	*See* N–89-25078			
1.15:102126	14:52927	*See* N–89-24577			
1.15:102136	14:52110	*See* N–89-24427			
1.15:4118	14:53863	*See* N–89-24255			
1.26:181375	14:53609	*See* N–89-24251			
1.26:181825	14:54054	*See* N–89-24058			
1.26:182291	14:52656	*See* N–89-23622			
1.26:183427	14:53087	*See* N–89-25051			
1.26:184909	14:53607	*See* N–89-24162			
1.26:184958	14:53606	*See* N–89-24142			
1.26:184973	14:53611	*See* N–89-25079			
1.26:184989	14:52850	*See* N–89-24669			
1.26:184990	14:53608	*See* N–89-24233			
1.26:185012	14:52904	*See* N–89-24599			
1.26:185056	14:52905	*See* N–89-24601			
1.26:185113	14:52030	*See* N–89-24445			
1.26:4238	14:52903	*See* N–89-23860			
1.55:10024	14:52531	*See* N–89-24626			
1.55:3030	14:52065	*See* N–89-24704			
1.55:3035-PT-1	14:52554	*See* N–89-23528			
1.55:3035-PT-2	14:52561	*See* N–89-23547			
1.60:2920	14:53842	*See* N–89-25103			
NASA-CP–					
10024	14:52531	*See* N–89-24626			
3030	14:52065	*See* N–89-24704			
3035-PT-1	14:52554	*See* N–89-23528			

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NASA-CP–					
3035-PT-2	14:52561	*See* N–89-23547			
NASA-CR–					
181375	14:53609	*See* N–89-24251			
181825	14:54054	*See* N–89-24058			
182291	14:52656	*See* N–89-23622			
183427	14:53087	*See* N–89-25051			
184909	14:53607	*See* N–89-24162			
184958	14:53606	*See* N–89-24142			
184973	14:53611	*See* N–89-25079			
184989	14:52850	*See* N–89-24669			
184990	14:53608	*See* N–89-24233			
185012	14:52904	*See* N–89-24599			
185056	14:52905	*See* N–89-24601			
185113	14:52030	*See* N–89-24445			
4238	14:52903	*See* N–89-23860			
NASA-TM–					
100327	14:52864	*See* N–89-24435			
100368	14:53610	*See* N–89-24260			
100643	14:52851	*See* N–89-24673			
101430	14:52487	*See* N–89-24635			
101548	14:52852	*See* N–89-24677			
101559	14:53651	*See* N–89-25104			
101986	14:52657	*See* N–89-23691			
101987	14:52926	*See* N–89-23465			
102003	14:52028	*See* N–89-23518			
102012	14:54079	*See* N–89-24443			
102016	14:52113	*See* N–89-23516			
102019	14:52108	*See* N–89-23517			
102032	14:52658	*See* N–89-24460			
102082	14:52118	*See* N–89-24451			
102097	14:52928	*See* N–89-25078			
102126	14:52927	*See* N–89-24577			
102136	14:52110	*See* N–89-24427			
4118	14:53863	*See* N–89-24255			
NASA-TP–					
2920	14:53842	*See* N–89-25103			
NBI-HE–					
89-30	14:53706	NTIS (US Sales Only), PC A03/MF A01		DE90712108	
89-31	14:53732	NTIS (US Sales Only), PC A03/MF A01		DE90712109	
NIIEFA-P-NILSA–					
07-89	14:53954	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90603249	
NIPER–					
322	14:51724	NTIS, PC A13/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000769	PC-125
437	14:51725	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001419	MF-125
NIRS-M–					
68	14:52328	NTIS (US Sales Only), PC A12/MF A01		DE90710177	
NIRS-R–					
16	14:53531	NTIS (US Sales Only), PC A08/MF A01		DE90710149	
NISTIR–					
89/4053	14:54058	*See* PB–89-216477/XAB			
89/4105	14:53554	*See* PB–89-214779/XAB			
89/4106	14:53245	*See* PB–89-209274/XAB			
NOAA-TM-ERL-ARL–					
171	14:53157	*See* PB–89-190219/XAB			
172	14:53179	*See* PB–89-208375/XAB			
NOAA/TM/NOS/OMA–					
44	14:53176	*See* PB–89-206809/XAB			
45	14:53265	*See* PB–89-206767/XAB			
47	14:53168	*See* PB–89-203889/XAB			
NORDITA–					
89/21-P(prepr.)	14:53720	NTIS (US Sales Only), PC A04/MF A01		DE90712067	
NOSC/TR–					
1277	14:53621	*See* AD-A–209251/8/XAB			
NPL–					
1056	14:53747	*See* DOE/ER/40269–T2			
NSS-R–					
136	14:52569	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90606347	
NSS/R–					
127	14:52659	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE90606362	

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NUREG–					
0040-Vol.13-No.2	14:52226	NTIS, PC A04/MF A01 - GPO - OSTI		TI90000188	
0750-Vol.29-Index-2	14:52227	NTIS, PC A04/MF A01 - GPO; OSTI; INIS		TI90001182	
0837-Vol.9-No.2	14:52278	NTIS, PC A11/MF A01 - GPO; OSTI; INIS		TI90001046	
0940-Vol.8-No.2	14:52228	NTIS, PC A17/MF A01 - GPO - OSTI		TI90001035	
0980-Rev.4	14:52229	NTIS, PC A11/MF A01 - GPO - OSTI		TI90001130	
1233	14:52330	NTIS, PC A03/MF A01 - GPO; OSTI; INIS		TI90000584	
1267	14:52331	NTIS, PC A03/MF A01 - GPO; OSTI; INIS		TI90000640	
1307-Rev.1	14:52332	NTIS, PC A03/MF A01 - GPO; OSTI; INIS		TI90001183	
1370	14:52333	NTIS, PC A10/MF A01 - GPO; OSTI; INIS		TI90000747	
NUREG/CR–					
2000-Vol.8-No.8	14:52230	NTIS, PC A08/MF A01 - GPO; OSTI; INIS		TI90001044	
3252	14:53570	NTIS, PC A11/MF A01 - GPO - OSTI		TI90001043	
4550-Vol.6-Rev.1-Pt.1	14:52334	NTIS, PC A23/MF A01 - GPO; OSTI; INIS		TI90000638	
4550-Vol.6-Rev.1-Pt.2	14:52335	NTIS, PC A99/MF A01 - GPO; OSTI; INIS		TI90000637	
4949	14:52279	NTIS, PC A04/MF A01 - GPO; OSTI; INIS		TI89017823	
5174	14:52336	NTIS, PC A10/MF A01 - GPO; OSTI; INIS		TI90000559	
5247	14:52280	NTIS, PC A08/MF A01 - GPO; OSTI; INIS		TI90001042	
5263	14:52337	NTIS, PC A09/MF A01 - GPO; OSTI; INIS		TI90000558	
NVO/AEIC–					
264	14:53225	*See* ORNL–6011			
OCS/MMS–					
89-0055	14:52415	OSTI - Minerals Management Service, 381 Elden Street, Herndon, VA 22070-4817		TI90001115	
OEHL–					
89-036EH0100EEF	14:53137	*See* AD-A–209426/6/XAB			
ONR–					
8-011-R	14:52605	*See* AD-A–209191/6/XAB			
ONRL–					
8-004-C	14:52606	*See* AD-A–209302/9/XAB			
ORNL–					
6011	14:53225	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90002111	MF-702
6527	14:52450	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000960	MF-350
6551/V2	14:53955	NTIS, PC A13/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000969	MF-420
6571	14:53899	NTIS, PC A11/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000979	MF-410
6581	14:51766	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000967	MF-400
ORNL/CON–					
253	14:52451	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000970	MF-350
282	14:52452	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001851	MF-350
291	14:52453	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000968	MF-350
ORNL/FEMA–					
89/2	14:53131	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90002112	MF-500
ORNL/FTR–					
2447	14:51878	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017292	MF-515
2454	14:53088	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017278	MF-413
2459	14:53532	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017306	MF-408
2475	14:52026	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017290	MF-426
2480	14:53956	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017410	MF-420
2496	14:53226	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017299	MF-408; MF-406
2498	14:53259	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017355	MF-402
2499	14:52027	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017298	MF-520
2518	14:53548	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017343	MF-408
2526	14:52248	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017294	
2528	14:52338	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017308	
2530	14:53290	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017346	MF-408
2535	14:53291	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017344	MF-408
2536	14:53549	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017309	MF-408
2540	14:53292	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017345	MF-408
2568	14:52249	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017307	
2602	14:53957	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017347	MF-420
2610	14:52339	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017349	
2611	14:52570	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017283	MF-404
2637	14:53533	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017348	MF-408
2650	14:52571	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017305	MF-404
2747	14:53612	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017297	MF-412
2759	14:52250	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017282	
2800	14:52572	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017300	MF-404
2805	14:53242	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017395	MF-420
2813	14:52503	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017289	
2840	14:53534	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017302	MF-408

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ORNL/FTR–					
2848	14:53413	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017409	MF-402
2909	14:52340	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017494	
3014	14:53916	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001297	MF-404
3018	14:54006	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90002137	MF-420
3021	14:53900	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001298	MF-404
3184	14:54007	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90002142	MF-420
3320	14:51767	NTIS, PC A12/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017560	MF-812
3374	14:53089	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001258	MF-414
3378	14:53156	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001094	MF-408
3383	14:53535	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001253	MF-402
3384	14:53901	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001249	MF-414
3386	14:53958	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001244	MF-420
3388	14:52098	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001096	MF-402; MF-408
3390	14:53293	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001095	MF-401
3392	14:53755	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001251	MF-413
3393	14:53550	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001248	MF-402
3394	14:53059	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001593	MF-414
3396	14:52236	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001247	MF-413
3399	14:53756	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001243	MF-413
3408	14:53090	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001495	MF-413
3409	14:54008	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001208	MF-420
3410	14:52145	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001576	MF-104
3413	14:53926	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001592	MF-411
3419	14:52046	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001295	MF-400
ORNL/M–					
836	14:53243	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001275	MF-402
919	14:54002	*See* DOE/ER–0313/6			
932	14:52454	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000972	MF-350
939	14:52573	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001004	MF-404
ORNL/NSIC–					
200-Vol.8-No.8	14:52230	*See* NUREG/CR–2000-Vol.8-No.8			
ORNL/RAP/Sub–					
89/97777/1	14:51863	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001843	MF-721
ORNL/RASA–					
89/4	14:53244	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001246	MF-511
ORNL/Sub–					
82-22239-01	14:51650	NTIS, PC A09/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001274	MF-114
85-55904/1	14:51651	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001585	MF-114
88-SA798/01	14:52146	NTIS (US Sales Only), PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001273	MF-114
88-SB775/01	14:51652	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001276	MF-114
88-SB964/1	14:52455	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001844	MF-350
ORNL/TM–					
10653	14:51768	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001860	MF-721
10955	14:52280	*See* NUREG/CR–5247			
11139	14:52393	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001242	MF-400
11140	14:54055	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001848	MF-405
11177	14:53959	NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000981	PC-427
11217	14:54009	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001856	MF-404
11233	14:52364	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000953	MF-202
11239	14:52624	NTIS, PC A23/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001852	MF-336
11253	14:54010	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000978	PC-426
11259	14:52416	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001855	MF-400
11287	14:53113	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90002095	MF-405
11288	14:52395	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001853	MF-400
11315	14:54056	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001858	MF-705
11321	14:53114	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000991	MF-700
ORNL/tr–					
89/35	14:51769	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000121	MF-406
OSHA/RP–					
89/003	14:52497	*See* PB–89-210199/XAB			
PATENTS-USA–					
4,842,964	14:52372	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,838,989	14:52706	Patent and Trademark Office, Box 9, Washington, DC 20232			
7-372,815	14:53411	NTIS, PC A03/MF A01			
PB–					
89-167894/XAB	14:53213	NTIS, PC A11/MF A01			
89-167902/XAB	14:53214	NTIS, PC A06/MF A01			

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89-167910/XAB	14:53215	NTIS, PC A25/MF A01			
89-188783/XAB	14:53247	NTIS, PC A15/MF A01			
89-190219/XAB	14:53157	NTIS, PC A03/MF A01			
89-192025/XAB	14:52489	NTIS, PC A06/MF A01			
89-192033/XAB	14:52490	NTIS, PC A15/MF A01			
89-196075/XAB	14:52491	NTIS, PC A06/MF A01			
89-196323/XAB	14:53158	NTIS, PC A06/MF A01			
89-197016/XAB	14:52492	NTIS, PC EE05/MF E05			
89-197156/XAB	14:53260	NTIS, PC A07/MF A01			
89-197214/XAB	14:53159	NTIS, PC A02/MF A01			
89-197321/XAB	14:52043	NTIS, PC A03/MF A01			
89-197370/XAB	14:52029	NTIS, PC A03/MF A01			
89-197453/XAB	14:53261	NTIS, PC A02/MF A01			
89-197743/XAB	14:53160	NTIS, PC A02/MF A01			
89-197875/XAB	14:52504	NTIS, PC EE03/MF E03			
89-197883/XAB	14:53161	NTIS, PC EE04/MF E04			
89-197909/XAB	14:53162	NTIS, PC EE05/MF E05			
89-197941/XAB	14:53163	NTIS, PC EE05/MF E05			
89-197958/XAB	14:53164	NTIS, PC EE06/MF E06			
89-197966/XAB	14:53165	NTIS, PC EE06/MF E06			
89-197974/XAB	14:52505	NTIS, PC EE05/MF E05			
89-197990/XAB	14:53166	NTIS, PC EE05/MF E05			
89-198089/XAB	14:52127	NTIS, PC A07/MF A01			
89-198097/XAB	14:53277	NTIS, PC A13/MF A01			
89-198246/XAB	14:53262	NTIS, PC A06/MF A01			
89-198287/XAB	14:52456	NTIS, PC A08/MF A01			
89-198303/XAB	14:52457	NTIS, PC A09/MF A01			
89-198345/XAB	14:52506	NTIS, PC EE05/MF E05			
89-198360/XAB	14:52964	NTIS, PC EE06/MF E06			
89-198394/XAB	14:52463	NTIS, PC A99/MF E04			
89-198626/XAB	14:52464	NTIS, PC A04/MF A01			
89-198634/XAB	14:52465	NTIS, PC A05/MF A01			
89-198642/XAB	14:52466	NTIS, PC A04/MF A01			
89-198667/XAB	14:52375	NTIS, PC A05/MF A01			
89-200828/XAB	14:53167	NTIS, PC A16/MF A01			
89-201347/XAB	14:51686	NTIS, PC A03/MF A01			
89-201354/XAB	14:51687	NTIS, PC A03/MF A01			
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89-201479/XAB	14:51691	NTIS, PC A03/MF A01			
89-201834/XAB	14:52522	NTIS, PC A03/MF A01			
89-202188/XAB	14:52376	NTIS, PC A07/MF A01			
89-202196/XAB	14:52377	NTIS, PC A18/MF A01			
89-202691/XAB	14:53211	NTIS, PC A24			
89-202709/XAB	14:53417	NTIS, PC A03/MF A01			
89-202717/XAB	14:53566	NTIS, PC A06/MF A01			
89-202725/XAB	14:53567	NTIS, PC A18/MF A01			
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89-202832/XAB	14:52386	NTIS, PC A04/MF A01			
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89-203913/XAB	14:53278	NTIS, PC A04/MF A01			
89-204002/XAB	14:52387	NTIS, PC A07/MF A01			
89-204101/XAB	14:52419	NTIS, PC A14/MF A01			
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89-204325/XAB	14:52388	NTIS, PC A06/MF A01			
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89-204358/XAB	14:51731	NTIS, PC A12/MF A01			
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89-204440/XAB	14:53264	NTIS, PC A04/MF A01			
89-204697/XAB	14:53169	NTIS, PC A06/MF A01			
89-204721/XAB	14:53170	NTIS, PC A99/MF E04			
89-205157/XAB	14:51692	NTIS, PC A08/MF A01			
89-205215/XAB	14:53408	NTIS, PC A16/MF A01			
89-205249/XAB	14:54057	NTIS, PC EE03/MF A01			
89-206031/XAB	14:53248	NTIS, PC A04/MF A01			

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89-206049/XAB	14:52493	NTIS, PC EE07/MF E07			
89-206171/XAB	14:51770	NTIS, PC A07/MF A01			
89-206643/XAB	14:53171	NTIS, PC A03/MF A01			
89-206676/XAB	14:53172	NTIS, PC A03/MF A01			
89-206718/XAB	14:53173	NTIS, PC A03/MF A01			
89-206726/XAB	14:53174	NTIS, PC A02/MF A01			
89-206734/XAB	14:53551	NTIS, PC A02/MF A01			
89-206742/XAB	14:53175	NTIS, PC A03/MF A01			
89-206767/XAB	14:53265	NTIS, PC A09/MF A01			
89-206809/XAB	14:53176	NTIS, PC A06/MF A01			
89-206858/XAB	14:51707	NTIS, PC A09/MF A01			
89-207021/XAB	14:53177	NTIS, PC A07/MF A01			
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89-207252/XAB	14:52965	NTIS, PC A02/MF A01			
89-207294/XAB	14:53553	NTIS, PC A03/MF A01			
89-207351/XAB	14:53266	NTIS, PC A03/MF A01			
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89-207476/XAB	14:53178	NTIS, PC A04/MF A01			
89-207575/XAB	14:52467	NTIS, PC A10/MF A01			
89-207823/XAB	14:52152	NTIS, PC A03/MF A01			
89-207831/XAB	14:52494	NTIS, PC A08/MF A01			
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89-207955/XAB	14:52153	NTIS, PC A13/MF A01			
89-207971/XAB	14:52468	NTIS, PC A06/MF A01			
89-207997/XAB	14:52469	NTIS, PC A09/MF A01			
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89-208144/XAB	14:52379	NTIS, PC A15/MF A01			
89-208151/XAB	14:52380	NTIS, PC A03/MF A01			
89-208375/XAB	14:53179	NTIS, PC A05/MF A01			
89-208391/XAB	14:53425	NTIS, PC A03/MF A01			
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89-209274/XAB	14:53245	NTIS, PC A04/MF A01			
89-209373/XAB	14:52470	NTIS, PC EE04/MF E04			
89-209670/XAB	14:53182	NTIS, PC A05/MF A01			
89-210199/XAB	14:52497	NTIS, PC A99/MF E16			
89-210579/XAB	14:52132	NTISMF A01			
89-210587/XAB	14:52524	NTISMF A01			
89-211114/XAB	14:52625	NTIS, PC A04			
89-211783/XAB	14:52390	NTIS, PC A05/MF A01			
89-213169/XAB	14:52381	NTIS, PC A08/MF A01			
89-214019/XAB	14:51653	NTIS, PC A05/MF A01			
89-214050/XAB	14:51654	NTIS, PC A03/MF A01			
89-214068/XAB	14:51728	NTIS, PC A05/MF A01			
89-214134/XAB	14:51679	NTIS, PC A05/MF A01			
89-214373/XAB	14:53280	NTIS, PC A04/MF A01			
89-214431/XAB	14:53183	NTIS, PC A03/MF A01			
89-214779/XAB	14:53554	NTIS, PC A03/MF A01			
89-214985/XAB	14:53268	NTIS, PC A05/MF A01			
89-215131/XAB	14:53281	NTIS, PC A04/MF A01			
89-215156/XAB	14:52391	NTIS, PC A08/MF A01			
89-215396/XAB	14:52512	NTIS, PC A04/MF A01			
89-215412/XAB	14:53269	NTISCP T03			
89-215883/XAB	14:52382	NTIS, PC A17/MF A01			
89-216477/XAB	14:54058	NTIS, PC A03/MF A01			
89-217897/XAB	14:53184	NTIS, PC A12/MF A01			
89-217939/XAB	14:52392	NTIS, PC A12/MF A01			
89-217947/XAB	14:51727	NTIS, PC A13/MF A01			
89-217962/XAB	14:53270	NTIS, PC A03/MF A01			
89-218002/XAB	14:52434	NTIS, PC A03/MF A01			
89-218010/XAB	14:52435	NTIS, PC A03/MF A01			
89-220545/XAB	14:52498	NTIS, PC A06/MF A01			
89-220578/XAB	14:52507	NTIS, PC A07/MF A01			
89-220586/XAB	14:53185	NTIS, PC A05/MF A01			

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89-863898/XAB	14:53282	NTISPC N01/MF N01			
89-864789/XAB	14:52383	NTISPC N01/MF N01			
89-865752/XAB	14:53283	NTISPC N01/MF N01			
89-865869/XAB	14:53186	NTISPC N01/MF N01			
89-867295/XAB	14:53271	NTISPC N01/MF N01			
89-867451/XAB	14:53555	NTISPC N01/MF N01			
89-867477/XAB	14:53272	NTISPC N01/MF N01			
89-867550/XAB	14:53960	NTISPC N01/MF N01			
89-867568/XAB	14:53961	NTISPC N01/MF N01			
89-867873/XAB	14:52575	NTISPC N01/MF N01			
89-868038/XAB	14:52499	NTISPC N01/MF N01			
89-868046/XAB	14:52500	NTISPC N01/MF N01			
89-868194/XAB	14:52929	NTISPC N01/MF N01			
89-868244/XAB	14:52865	NTISPC N01/MF N01			
89-868277/XAB	14:52866	NTISPC N01/MF N01			
89-868400/XAB	14:54075	NTISPC N01/MF N01			
89-868590/XAB	14:52041	NTISPC N01/MF N01			
89-868897/XAB	14:52660	NTISPC N01/MF N01			
PFC/RR–					
89-13	14:53932	*See* DOE/ET/51013–275			
PITHA–					
89/11	14:53707	Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Experimentalphysik 3B und 3. Physikalisches Inst.			
89/12	14:53708	Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Experimentalphysik 3B und 3. Physikalisches Inst.			
PNL–					
6853	14:51771	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000921	
6889-HEDR	14:53536	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000919	MF-707
6917	14:51772	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000993	MF-702
6967	14:51773	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000950	MF-804
7104	14:52147	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001863	MF-114
7134	14:53228	NTIS, PC A12/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000988	MF-502
7135	14:53537	NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000983	MF-603
PNL-SA–					
16496-1	14:53187	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001394	MF-402
16636	14:53273	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001390	MF-408
16663	14:51774	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001395	MF-512
17154	14:53571	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001393	
17173	14:52413	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001391	MF-502; MF-506
17406	14:54059	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001992	MF-505
POEF–					
2006	14:52384	NTIS, PC A19/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001387	MF-602
PPPL–					
2652	14:54011	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001864	PC-427
PUB–					
134	14:53280	*See* PB–89-214373/XAB			
PWR/HTWG/P–					
(88)630	14:52923	*See* CEGB-RD/L–3429/R88			
RAL–					
89-046	14:53902	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE90605726	
89-047	14:53709	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90606097	
89-056	14:53091	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90606821	
89-057	14:53903	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE90605727	
RDA-TR–					
113400-006	14:53130	*See* AD-A–209336/7/XAB			
REPT–					
88-15	14:52418	*See* PB–89-203087/XAB			
RERF-TR–					
1-89	14:53538	NTIS (US Sales Only), PC A03/MF A01		DE90710065	
7-88	14:53539	NTIS (US Sales Only), PC A03/MF A01		DE90710064	
RFP–					
4344	14:51775	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017713	MF-721
RRK–					
89-12	14:53721	NTIS (US Sales Only), PC A04/MF A01		DE90710099	

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89-13	14:53733	NTIS (US Sales Only), PC A02/MF A01		DE90710100	
89-14	14:53615	NTIS (US Sales Only), PC A03/MF A01		DE90710101	
RTR–					
2298	14:52255	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001314	MF-706
SAAS–					
376	14:51879	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90606937	
377	14:53864	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE90606105	
SAND–					
86-2084-Vol.6-Rev.1-Pt.1	14:52334	*See* NUREG/CR–4550-Vol.6-Rev.1-Pt.1			
86-2084-Vol.6-Rev.1-Pt.2	14:52335	*See* NUREG/CR–4550-Vol.6-Rev.1-Pt.2			
87-0558	14:52195	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016962	PC-522
88-1607	14:52336	*See* NUREG/CR–5174			
88-2416	14:54060	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001865	MF-705
88-3100	14:52337	*See* NUREG/CR–5263			
88-3305C	14:52996	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001093	MF-706
88-7149	14:52099	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000898	MF-237
89-0397	14:52471	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000892	MF-900
89-0640	14:52867	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000927	MF-400
89-0761	14:53115	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000895	MF-706
89-0854C	14:53904	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001176	MF-411
89-0859	14:52341	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000041	PC-742
89-0986C	14:52133	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000803	MF-261
89-1177	14:53569	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000896	MF-703
89-1197	14:53574	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016963	PC-510
89-1257	14:51776	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000893	MF-721
89-1286	14:52868	NTIS, PC A09/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000926	MF-705
89-1322C	14:52576	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000674	MF-700
89-1396	14:52134	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000958	MF-905
89-1397	14:52869	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000925	MF-905
89-1423C	14:53116	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014494	MF-705
89-1535C	14:52135	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000810	MF-261
89-1571	14:52577	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000891	MF-704
89-1641C	14:52870	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014496	MF-706
89-1656C	14:52871	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001091	MF-706
89-1674	14:52661	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000894	MF-600
89-1678C	14:52872	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000790	MF-706
89-1680C	14:52873	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001092	MF-706
89-1852C	14:52368	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015847	MF-212
89-1886C	14:52369	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015846	MF-700
89-1914C	14:52370	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016181	MF-212
89-1915C	14:51777	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001172	MF-721
89-1968	14:52117	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000922	MF-231
89-1976C	14:52955	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001384	MF-706
89-2011C	14:53098	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001175	MF-706
89-2114C	14:52997	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000804	MF-705
89-2127C	14:53035	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001386	MF-420
89-2135C	14:51778	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000665	MF-814
89-2155C	14:53652	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000807	MF-700
89-2158	14:52956	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001866	MF-705
89-2181C	14:53036	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000805	
89-2288C	14:54061	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000809	MF-700
89-7103C	14:52371	NTIS, PC A02/MF A01 - OSTI		DE89015843	MF-700
89-8009	14:52833	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000917	MF-401
SCI–					
5103-1	14:52491	*See* PB–89-196075/XAB			
5103-2	14:53158	*See* PB–89-196323/XAB			
SCIENTIFIC–					
1	14:53126	*See* AD-A–208525/6/XAB			
4	14:53622	*See* AD-A–209348/2/XAB			
SD-TR–					
89-64	14:53037	NTIS, PC A03/MF A01 - OSTI		DE90000069	
SERI/STR–					
211-3508	14:52100	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009419	MF-271
211-3525	14:52101	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009436	MF-271
211-3526	14:52102	NTIS, PC A04/MF A01 - OSTI		DE89009444	MF-271
211-3527	14:52103	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009438	MF-274

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SGD–					
537-PT-1	14:53613	*See* PB–89-207393/XAB			
537-PT-2	14:53614	*See* PB–89-207401/XAB			
SLAC-PUB–					
4946	14:52976	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89014592	PC-414
5000	14:53679	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000946	PC-414
5056	14:52998	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000945	PC-414
5061	14:53680	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000944	PC-414
5070	14:53038	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000942	PC-414
5075	14:52977	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000941	PC-414
5082	14:53681	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000940	PC-414
5087	14:53682	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000939	PC-414
5088	14:53710	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000938	PC-414
5091	14:52999	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000937	PC-414
5093	14:53683	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000936	PC-414
5094	14:53684	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000935	PC-414
SRI-ENV–					
89-826-6657-XV	14:52149	*See* DOE/PC/88867–T4			
89-853-6666	14:51676	*See* DOE/PC/88868–T2			
STAN-CS–					
89-1246	14:54037	*See* AD-A–209606/3/XAB			
SUPRI-TR–					
68	14:51714	*See* DOE/BC/14126–11			
69	14:51715	*See* DOE/BC/14126–12			
SVF–					
290	14:51699	Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)			
SWRI–					
5483	14:51692	*See* PB–89-205157/XAB			
TR–					
0088(3940-06)-7	14:53619	*See* AD-A–208943/1/XAB			
20	14:52604	*See* AD-A–208980/3/XAB			
29	14:54031	*See* AD-A–209265/8/XAB			
TR-EL–					
82-4/82(11.105)	14:53249	*See* BR–82(11.105)			
82-4/82(11.106)	14:53250	*See* BR–82(11.106)			
82-4/82(11.108)	14:53251	*See* BR–82(11.108)			
82-4/82(11.109)	14:53252	*See* BR–82(11.109)			
82-4/82(11.110)	14:53253	*See* BR–82(11.110)			
82-4/82(11.112)	14:53254	*See* BR–82-(11.112)			
TRB/SR–					
218-VOL-1	14:52376	*See* PB–89-202188/XAB			
218-VOL-2	14:52377	*See* PB–89-202196/XAB			
221	14:52463	*See* PB–89-198394/XAB			
TRB/TRR–					
1170	14:52375	*See* PB–89-198667/XAB			
1173	14:52466	*See* PB–89-198642/XAB			
1174	14:52465	*See* PB–89-198634/XAB			
1175	14:52464	*See* PB–89-198626/XAB			
1176	14:53169	*See* PB–89-204697/XAB			
TRI-PP–					
89-51	14:53711	NTIS (US Sales Only), PC A02/MF A01 - OSTI		DE90001190	
89-52	14:53712	NTIS (US Sales Only), PC A02/MF A01 - OSTI		DE90001187	
89-53	14:53843	NTIS (US Sales Only), PC A02/MF A01 - OSTI		DE90001192	
89-54	14:53761	NTIS (US Sales Only), PC A02/MF A01 - OSTI		DE90001186	
89-65	14:53757	NTIS (US Sales Only), PC A02/MF A01 - OSTI		DE90001188	
89-69	14:53758	NTIS (US Sales Only), PC A02/MF A01 - OSTI		DE90001189	
TSU/WP–					
416	14:52470	*See* PB–89-209373/XAB			
UBA-FB–					
86-101	14:52961	Copy held by UB/TIB Hannover.			
87-092/1.1.1	14:53188	Copy held by UB/TIB Hannover.			
87-092/1.1.2	14:53189	Copy held by UB/TIB Hannover.			
87-092/1.2.1	14:53190	Copy held by UB/TIB Hannover.			
87-092/1.2.2	14:53191	Copy held by UB/TIB Hannover.			
87-092/1.2.3	14:53192	Copy held by UB/TIB Hannover.			
87-092/1.3	14:52154	Copy held by UB/TIB Hannover.			
87-092/2.1	14:53193	Copy held by UB/TIB Hannover.			
87-092/2.2	14:53194	Copy held by UB/TIB Hannover.			
87-092/2.3	14:53195	Copy held by UB/TIB Hannover.			
87-092/5	14:53196	Copy held by UB/TIB Hannover.			

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87-092/6	14:53197	Copy held by UB/TIB Hannover.			
UCID–					
21753	14:52662	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000859	MF-704
21757	14:52834	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000956	MF-701
21764	14:53229	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000932	MF-702
21801	14:52906	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000931	MF-706
21803	14:52907	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000879	MF-706
21809	14:53927	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000930	MF-700
21811	14:51779	NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000929	MF-510
UCLA/PPG–					
1263	14:53962	NTIS, PC A04/MF A01; OSTI; INIS		DE90000948	PC-420; PC-421; PC-423; PC-426;
UCRL–					
100678	14:53556	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001020	MF-707
100786	14:52908	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000783	MF-704
100795	14:53134	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001024	MF-702
100796	14:52578	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001683	MF-701
101066	14:52978	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001515	
101099	14:54012	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001165	MF-422
101108	14:52663	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015119	
101131	14:54013	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90000816	MF-422
101136	14:54014	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001514	MF-420
101137	14:53118	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000782	MF-700
101193	14:53039	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001506	MF-700
101215-Rev.1	14:53209	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001053	MF-610
101241	14:54015	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001519	MF-420
101590	14:53302	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001090	MF-408
101613	14:53819	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001508	MF-700
101688	14:53038	*See* SLAC-PUB–5070			
101709	14:53572	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017886	MF-703; MF-741
101728	14:53300	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90001652	
101850	14:53230	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90001513	MF-702; MF-707
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IR	Iran
IS	Iceland
IT	Italy
JM	Jamaica
JO	Jordan
JP	Japan
KE	Kenya
KH	Democratic Kampuchea
KP	Democratic People's Republic of Korea
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SN	Senegal
SO	Somalia
SU	Union of Soviet Socialist Republics (USSR)
SV	El Salvador
SY	Syria
SZ	Swaziland
TD	Chad
TG	Togo
TH	Thailand
TN	Tunisia
TO	Tonga
TR	Turkey
TT	Trinidad and Tobago
TW	Taiwan
TZ	United Republic of Tanzania
UA	Ukrainian Soviet Socialist Republic (Ukrainian SSR)
UG	Uganda
US	United States of America (USA)
UY	Uruguay
VA	Holy See
VE	Venezuela
VI	Virgin Islands of the United States
VN	Viet Nam
WS	Western Samoa
YD	Democratic Yemen
YE	Yemen
YU	Yugoslavia
ZA	South Africa
ZM	Zambia
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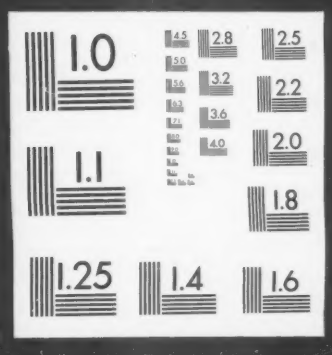
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